Popular Astronomy.

Vol. XXXIV, No. 5 MAY, 1926 Whole No. 335

REPORT ON MARS, NO. 35.

By WILLIAM H. PICKERING.

THE APPARITION OF 1924, CONTINUED.

Our last Report contained the drawings of four of the eight observers whose work was accepted this year for publication. The present Report contains the drawings of the remaining four, one American, and three from Asiatic stations. These are arranged as heretofore in the order of their longitudes. The designations, localities, and equipment of these astronomers are as follows:

D Professor A. E. Douglass, Tucson, Arizona. 36-inch reflector by Brashear, but the aperture reduced at different times by eccentric diaphragms to 14, 10, and 6 inches. Magnification 220. Seeing not recorded.

N K. Nakamura, Esq., Kyoto, Japan. Reflectors of 10 and 6.5 inches aperture by Brashear, and Ellison, and apochromatic refractor of 7 inches by Zeiss. Magnifications 270, 240, and 200. Seeing on Standard Scale 6 to 9.

S R. Schofield, Esq., Kobe, Japan. 8.5-inch Calver reflector. Magnifications 235, 245, and 310. Seeing on Standard Scale 7 to 9.

E Dr. F. O'B. Ellison, Colombo, Ceylon. 12-inch reflector. Mirror by Rev. W. F. A. Ellison, mounting by himself. Magnifications 200, 275, and 500. Seeing approximately on Standard Scale 5 to 8.

It will be noticed that Professor Douglass has changed from an 8-inch Clark refractor, used at all the previous apparitions, to a 36-inch Brashear reflector. The 8-inch evidently gave excellent definition, as we find that with it he generally held the record for the largest number of confirmed canals seen by any of our observers. It was returned to Harvard in 1923, at their request, as they wanted to loan it for observations of variable stars. Fortunately Douglass secured the reflector in time for use at the apparition of 1924. Unfortunately, however, for Martian observations, the refractor appears to have been the better instrument, as will appear by Tables III and IV, according to which four of the observers saw many more confirmed canals than he. More complete figures for the whole planet will be given in a future Report. Nakamura also obtained two new reflectors, which he was able to use to advantage for three of his drawings. We are very glad to welcome a new observer this year, Dr. Ellison in the island of Ceylon, who by using one of his brother's mirrors was able to see many canals.

As in our former reports, the drawings of the observers are so arranged that all in the same horizontal row shall represent approximately the same longitude on the planet. In the vertical columns the longitudes are intended to differ by just 60°, beginning with 0°. Thus six views of the planet are contributed by each observer, covering the whole visible surface. The six regions are indicated by the letters **A**, **B**, **C**, **D**, **E**, and **F**. In Table I is given a statement of the main facts relating to the various drawings. The Table is arranged as in previous Reports, the successive columns giving the number of the figure, the designation of the observer, the aperture of the instrument, the magnification employed, the seeing on the Standard Scale, which is described in Report No. **9**, the date of the drawing, the region depicted, the longitude of the central meridian, its deviation from the desired standard, the latitude of the center of the disk, the angular diameter of the planet, the longitude of the sun as seen from Mars, as described in the Ephemeris, and the corresponding Martian Date, taken from Report No. **10**.

TABLE I.

Fig.	Ob.	Apr.	Mag.	S.	1924	R. Long.	ΔLong.	Lat.	Diam.	☉	M. D.
						°	°	°	″	°	
25	D	6	220	—	Sept. 1 **A**	354	— 6	—16	24.6	248.3	Nov. 33
26	N	10	270	9	Aug. 14 **A**	355	— 5	—17	24.8	236.8	Nov. 16
27	S	8.5	235,310	7	Sept. 16 **A**	350	—10	—17	22.5	257.8	Nov. 48
28	E	12	200,275	—	Oct. 25 **A**	20	+20	—21	15.3	282.1	Dec. 31
29	D	6,10	220	—	Aug. 27 **B**	43	—17	—16	25.0	245.1	Nov. 29
30	N	7	240	9	Sept. 7 **B**	87	+27	—16	24.0	252.0	Nov. 39
31	S	8.5	235,310	8,9	Oct. 13 **B**	67	+ 7	—19	17.3	274.7	Dec. 19
32	E	12	200.500	—	Sept. 14 **B**	60	0	—16	22.8	256.5	Nov. 46
33	D	6,14	220	—	Aug. 24 **C**	81	—39	—16	25.1	243.2	Nov. 26
34	N	7	240	7.6	Sept. 6 **C**	108	—12	—16	24.1	251.4	Nov. 38
35	S	8.5	235,310	8,7	Aug. 1 **C**	120	0	—17	23.3	228.6	Nov. 3
36	E	12	200	(5)	Sept. 9 **C**	105	—15	—16	23.7	253.3	Nov. 41
37	D	6	220	—	Aug. 16 **D**	161	—19	—16	24.9	238.1	Nov. 18
38	N	7	240	8	Aug. 30 **D**	177	— 3	—16	24.8	247.0	Nov. 31
39	S	8.5	235	7,8	Sept. 29 **D**	210	+30	—18	20.0	266.0	Dec. 5
40	E	12	275	(7)	Aug. 30 **D**	200	+20	—16	24.8	247.0	Nov. 31
41	D	14	220	—	Aug. 7 **E**	244	+ 4	—17	24.1	232.4	Nov. 9
42	N	6.5	200	8,9	Aug. 22 **E**	247	+ 7	—16	25.1	241.9	Nov. 24
43	S	8.5	235,310	7,8	Sept. 25 **E**	270	+30	—17	20.8	263.4	Dec. 1
44	E	12	200,275	(8)	Aug. 24 **E**	255	+15	—16	25.1	243.2	Nov. 26
45	D	6	220	—	Sept. 13 **F**	292	— 8	—16	23.0	255.8	Nov. 45
46	N	6.5	200	9	Aug. 23 **F**	302	+ 2	—16	25.1	242.6	Nov. 25
47	S	8.5	235	8	Aug. 18 **F**	300	0	—16	25.0	239.4	Nov. 20
48	E	12	275	(7)	Aug. 20 **F**	310	+10	—16	25.1	240.6	Nov. 21

The average date of the drawings was September 3, or 11 days after the opposition. The average hitherto has been 8 days, with a tendency to be earlier in our winter months. Low magnifications were the rule, only one observer on only one occasion venturing to use anything higher than 310. This was perhaps natural, since with the exception of Nakamura's 7-inch, all the instruments were reflectors. Reflectors of the usual size being of short focus, high magnifications are impossible to obtain, without the use of high power eye-pieces, which are objectionable. This difficulty can of course be overcome by means of a Barlow lens, but this device does not seem to be in very general use.

Remarks of the Observers.

Professor Douglass makes no comment on his drawings, but Messrs. Nakamura and Schofield were both struck by a conspicuous rift in the polar cap nearly parallel to its northern edge, which appeared to them independently on July 9, and which both were certain was covered by a yellow cloud on the previous night. This rift on account of its orientation was a very curious phenomenon of this apparition, and was first detected here on May 10. It was not continuously visible however until later in the season. We were unable to secure any observations here on July 7, 8, or 9, or we might have recorded how it appeared as seen from the opposite direction on the planet to the Japanese observers. The peculiarity of the rift was that it was always seen nearly parallel to the edge of the snow, no matter what the central meridian of the planet. This of course implied a ring structure, and it was in fact so seen by Hamilton for three weeks in June. Channels radiating from it towards the edge of the snow were detected on June 19, 20, and 21. On only June 20 did I get a drawing of it, and the structure then appeared to me to be very irregular, but not as a ring. Two channels were seen that were nearly radial, but neither of them quite reached the rim. This may have been due to invisible cloud, because water does undoubtedly surround the cap in the form of marshes, when the snow is melting rapidly.

On August 14 Nakamura doubled Gehon, and perhaps Euphrates, Figure 26. This is not confirmed elsewhere, and he suggests that it may in this case have been due to the doubling of the images that is often seen in reflectors when first opened for the night's work, due to air currents in the tube. Nectar, Cerberus, Ganges, and Nepenthes were also seen at times to be double, but as is usually the case, no matter what the size of the telescope, they were doubled only by glimpses. He finds the duplication is confined to rather broad sharply defined canals, and he believes it is not genuine, but is perhaps a contrast effect. He also notes that, when a lightly shaded region crosses a desert, he has a tendency to see a canal at the boundary, but he believes that also to be due to contrast. On September 7 he saw clearly four of the dark region canals, Figure 30. He found Juventae a rather difficult object, but Sirenius and a lake at its end, perhaps Biblis, were easily seen, Figure 38. Central clouds were seen over the deserts near Ganges. He detected the marked change that occurred in the shape of Nepenthes. It disappeared in July, but was conspicuous again in August. He as well as Schofield noted a very marked darkening in Libya early in November, which fully explains the complete change in shape of the Syrtis noted here between October 19 and November 18. We must defer a detailed description of it however until our next report.

Nakamura makes an interesting comparison of his 6.5-inch reflector and his 7-inch refractor. Both he says have their individual advantages. The latter is better when the seeing is poor, as is always found to be the case with refractors, but when good, the former gives stronger con-

trasts, and sharper definition, so that the canals are more easily seen with it. He states that the canals always appeared to him broad, and never like spider lines. This of course was due to his small aperture, with which the finer canals would never be visible. He also says that he draws only those canals of which he is sure, never those which he merely suspects, or sees by glimpses. This plan cannot be impressed too strongly on the young, would-be, Martian observer. Dr. Ellison also gives us some very interesting information regarding his last observations of Mars in 1925, but this we must defer to our next report.

Thaumasia.

This bright area, which immediately surrounds the conspicuous dark marking known as Solis Lacus, is one of the most interesting regions upon Mars, as well as the most striking one in appearance when the southern hemisphere of the planet is turned towards the Earth. The area that we shall consider lies mainly between the equator and latitude 50° south, and between longitudes 60° and 120°. It measures linearly 1900 by 2400 miles, and covers therefore 4,500,000 square miles of territory, or about once and a half the area of the United States or of Europe.

In order to map it, and to discuss the changes occurring within it due to the progress of the seasons, we need at least a few accurate fundamental positions. Eight of these have already been published and mapped in Report No. **33**, dealing with the apparitions of 1914 to 1922, when the northern hemisphere was turned towards the sun, and this region was experiencing its winter. The winter solstice of the planet, which was midsummer for Thaumasia, occurred in 1924 during the latter part of our September, when Mars was still quite near the earth, and over 20″ in diameter. This region was therefore well seen at that time.

A comparison of our drawings made in that year with those made at previous apparitions showed at once that certain changes in detail had taken place, most noticeably in the shape of Solis itself, and the canal Nectar joining it to Aurorae, the mare lying to the east of it. It was seen that the distance from Maeisia to Aurorae had also very obviously increased, and that Phoenicis appeared to have moved farther south. Formerly, during its colder season, the water had reached this region from the melting of the northern polar cap, but now the water was pouring down from the southern one, due to the evaporation and melting of the snow, and it was clear that very different conditions prevailed. It was therefore decided to locate these same eight points over again, based solely on the drawings of 1924. On comparing the results of the two surveys it was found that the longitudes on the average had shifted some two degrees eastward, but that the mean latitude had moved southerly only 0°.2, or about seven miles, owing clearly chiefly to the large southerly individual motion of Phoenicis. Had we been obliged to use the data given in the Ephemeris, it would have appeared

that the mean motion of the eight points in latitude was —1°.4, or comparing them with their latitudes in 1922, —1°.3, or about fifty miles southerly. Incidentally this is the direction in which we predicted that the Ephemeris data would apparently cause the whole surface of the planet to move (see last paragraph of Report No. **28**). The apparent shift southerly will be continued and increased at this year's and at the next apparition, unless the Ephemeris for 1928 can be corrected before that time.

In Table II, following the name of the station, the second column gives the number of nights on which it was measured during the apparitions of 1914 to 1922 inclusive, and the third and fourth its deduced latitude and longitude, each followed by the probable error of the mean. The next three columns give similar results for the apparition of 1924, and the last two the mean of the two latitudes and the two longitudes. These last are used as the foundation of the accompanying map, Figure 50. In 1924, Nectar for a part of the time did not reach Aurorae except as a threadlike canal, but the eastern end of the canal is the point measured in each of these surveys. The fourth and sixth points are arcs lying in an east and west direction. Their longitudes are therefore indefinite. The map is published on orthographic projection, with the center of the disk in latitude —15°. Consequently when that latitude is central on the disk, with longitude 90° also central, the map will show the planet exactly as it appears in the sky, with no distortion whatever.

TABLE II.

LATITUDES AND LONGITUDES IN AND AROUND THAUMASIA.

	1914 to 1922			1924			Mean	
Station	No.	Lat.	Long.	No.	Lat.	Long.	Lat.	Long.
		°	°		°	°	°	°
Juventae S.	3	— 5.0±0.4	62.7±2.0	4	— 3.0±0.9	60.4±0.5	— 4.0	61.6
Nectar p.	10	—25.5±1.1	63.5±1.2	5	—23.1±0.4	57.8±0.5	—24.3	60.6
Maeisia	5	—11.5±0.5	72.4±1.3	3	—12.3±0.7	72.3±0.7	—11.9	72.4
Solis N.	5	—21.9±0.5	84.7±2.2	5	—24.6±0.3	81.1±1.6	—23.2	82.9
Solis f.	5	—28.0±1.1	94.1±2.1	5	—29.6±0.5	91.0±1.3	—28.8	92.6
Thaumasia S.	4	—46.6±1.0	95.0±1.6	4	—44.2±0.4	87.5±1.3	—45.4	91.2
Phoenicis	7	—12.0±0.8	106.5±0.8	5	—16.8±0.7	105.1±0.6	—14.4	105.8
Thaumasia f. M.	2	—32.8±1.0	124.6±4.4	5	—31.3±1.1	123.8±0.6	—32.0	124.2

A map of Thaumasia on Bonne's conical projection (Figure 49) based on observations made with the great telescope at Meudon has also been published by M. Antoniadi in *L'Astronomie*, 1924, **38**, 426. Its limiting latitudes agree well with ours, but its limiting longitude on the west is 5°, and on the east 9° higher than our own. If his longitudes of the other Martian markings differ from ours in the same direction, and to the same extent, that will fully account for his statement, p. 429, and that of M. Baldet of the same observatory, 1925, **39** 35, that the longitudes given in the *American Ephemeris*, on which all European as well as all American observers depend, are about 4° too high. We trust that no change will be made in the longitudes. They appear to us to be correct, as compared with those of the last thirty

years. We have been inconvenienced enough by the former change of —4°.8 introduced into the Ephemeris in 1896. The two French observers also criticise the latitudes, and what they say there is more or less true, and similar criticisms have reached me from other directions. The mistake made, however, is in supposing that the error exists only in the inclination of the planet's axis. That error is less than 1°. The large error that is causing most of the trouble is, as we have already shown, the erroneous azimuth, which affects the node.

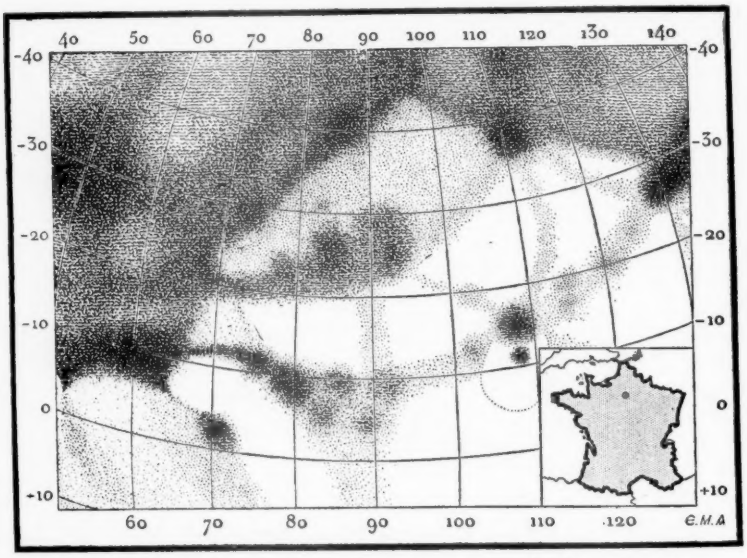


Fig. 49. Map of Thaumasia on Bonne's conical projection, drawn by M. Antoniadi from observations made with the great telescope at Meudon in 1924. From *L'Astronomie*, 1924, **38**, 426.

The details of the map, Figure 50, are taken from my drawings, published and unpublished, modified in those places where it seemed desirable to do so by those of Mr. Hamilton, Dr. Trumpler, and the other observers. Regarding the shape of the principal formations the drawings of these three observers, as may be seen in Report No. **34**, are practically identical, the chief modifications necessary relating to the insertion of certain lakes and canals. It should be stated here that no canal or lake has been inserted on the map unless it was seen by at least two observers at this apparition, or unless it was confirmed by some drawing at a previous apparition by some other observer. It will indeed appear later by Tables III and IV that there was but one of the inserted canals, number 16, and only one of the lakes, number 9, which were not seen by at least three different observers.

M. Antoniadi shows perhaps 12 canals in all upon his map, of which

one, Hyscus, although evidently conspicuous, was apparently visible for a few days only, and is therefore interesting. It was not seen by any of our eight observers. It was certainly not visible here in August, when we studied this region very carefully, and it was not seen by any of our Asiatic observers as late as September 14. It was first recognized by one of our European members, Mr. Phillips, on September 17, M. N. 1924, **85**, 184, Plate 8, Figure 1, and was last recorded by M. Baldet on the 19th, Figure 54. The writer obtained two drawings on

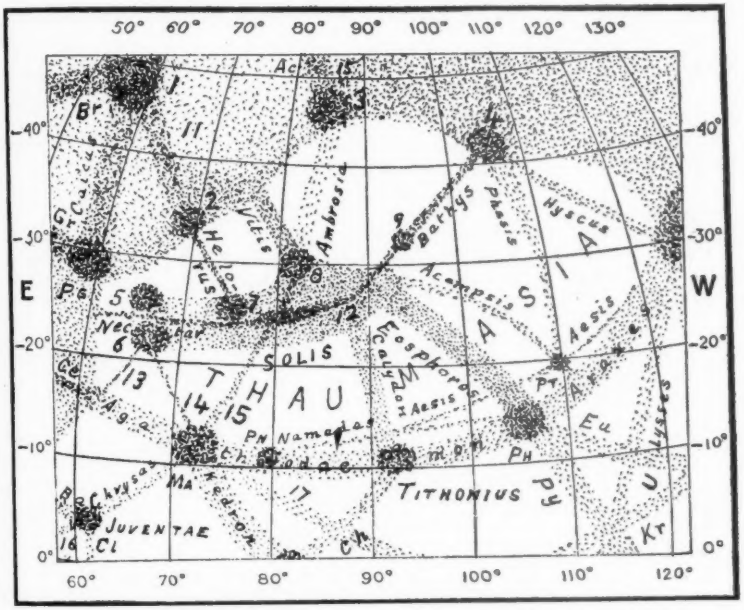


Fig. 50. Map of Thaumasia drawn by Professor W. H. Pickering from observations in 1924.

that same date, made perhaps 6 hours later, seeing 8, and others on September 20, 22, and 28. On none of these drawings was the canal visible. On the last date Hamilton also observed the region, and again on October 1, when he detected 8 of the confirmed canals, but did not see this one. Since neither of us saw the canal, in spite of its obviously conspicuous character to European observers, it is presumable, as far as it is possible for negative evidence to go, that it was not visible after September 19, and perhaps not before the 15th.

Antoniadi's 11 other canals were all seen by our observers, in general by six or more of them. We confirmed in all 23 canals not shown on his map. He shows 23 lakes, of which we were able to confirm 12, the remaining 11 being seen by none of our observers. We wish he had

given us more information regarding these numerous lakes. For instance if they were all seen with one instrument, and by one observer only, or if they were confirmed by others. We also would like to know which ones were seen on more than one night. We attach little value to unconfirmed lakes, and in some cases consider them worse than useless, because misleading, and perhaps non-existent.

It is certainly creditable to his judgment that he should not have recorded any canals of which he was not certain, and that we should have been able to confirm so fully all that he did show. Of the 23 on the other hand which he could not see, four, namely Caicus, Chrysorrhoas, Kedron, and Vitis, were seen respectively by 4, 5, 6, and 7 of our observers. The remainder were all either faint, or more generally were very fine lines. He however, unfortunately, then goes on to state very explicitly that no such lines exist. (Translation) "We affirm in the most categorical fashion that no inextricable system of fine lines exists on Mars." p. 429. We think that he might at least have said that he had seen no such system. That would have been logically more sound than a "universal negation," and would have had the further incidental advantage of being true. M. Baldet of the same observatory, and in the same magazine, for 1925, **39**, 35, makes a similar, but more cautious statement.

We regret to notice in M. Antoniadi's article the unnecessary virulence of his attack on the late Dr. Lowell. Of course Lowell made mistakes, as every one else does, and it is unfortunate that Marth and Crommelin should have put as much of his work as they did into the Ephemeris, which affects us all alike. It is also perfectly true that Lowell could not draw. The canals do not look in the least as he depicted them. But at the same time he did a good deal of work which was very good, particularly in regard to the finer canals and more minute lakes, which could not at that time be seen elsewhere. This, his best work, and to which he devoted the most of his time, is that part for which sidereal astronomers now chiefly and wrongly criticize him. That is to say, they say little about the unsatisfactory part of his work, but criticize him for that which is good. I have no doubt but that with the exception of the duplications, which are doubtful, nearly all of the minute canals and lakes that he drew were really there—at the time that he drew them. Many of these canals, however, seem to have been merely temporary affairs, which perhaps were never to appear again in the same locality. Others might reappear for a short time at intervals, and these last we are now endeavoring to identify and segregate—particularly those which, like many of Schiaparelli's, appear regularly at successive apparitions. In the region under discussion Lowell in 1909 drew 21 lakes. Antoniadi in 1924 shows us, as we have just seen, 23.

Some confusion regarding the nomenclature of this region has arisen, since different authorities have given different names to its principal canal, stretching from Aurorae Sinus on the left of the map,

PLATE XI.

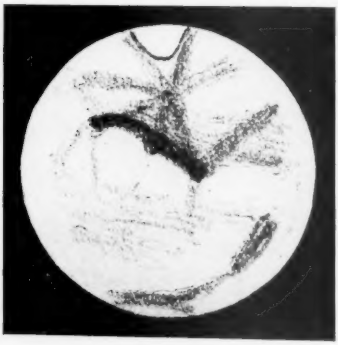


Fig. 37
Douglass 161° D

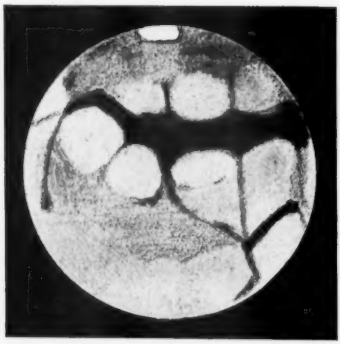


Fig. 38
Nakamura 177° D

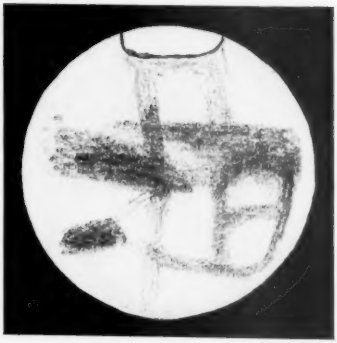


Fig. 41
Douglass 244° E

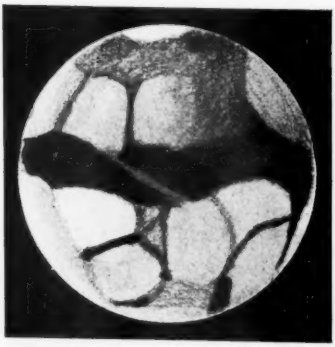


Fig. 42
Nakamura 247° E

Fig. 45
Douglass 292° F

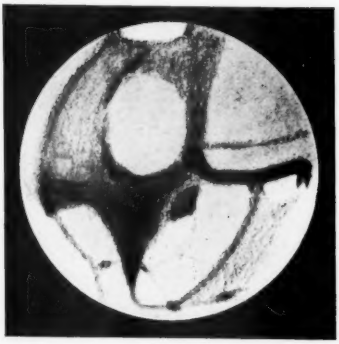


Fig. 46
Nakamura 302° F

DRAWINGS OF MARS IN 1924.

PLATE XII.

Fig. 39
Schofield 210° D

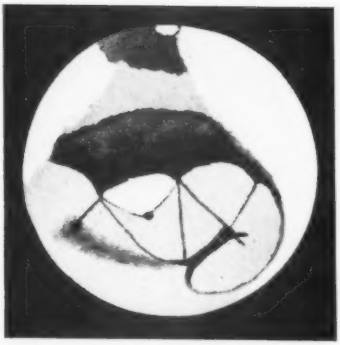


Fig. 40
Ellison 200° D

Fig. 43
Schofield 255° E

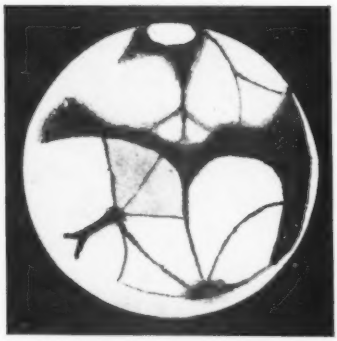


Fig. 44
Ellison 255° E

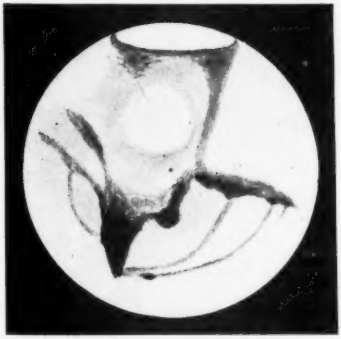


Fig. 47
Schofield 300° F

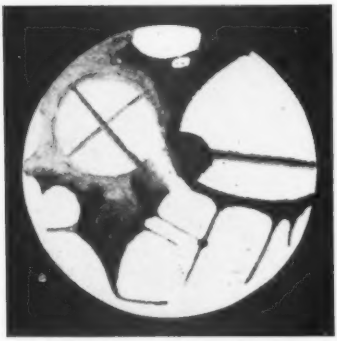


Fig. 48
Ellison 310° F

DRAWINGS OF MARS IN 1924.

to Lacus Phoenicis shown on the right. This canal may for convenience of description be divided into three nearly equal lengths, (a) that portion stretching from Aurorae to Maeisia, (b) that from Maeisia to Tithonius, and (c) that from Tithonius to Phoenicis. In Schiaparelli's original maps of 1877 and 1879 he called the whole of it Agathodaemon. That portion of it near Aurorae he represented in 1877 as two distinct canals uniting before they reached what is now called Maeisia. To the southern of these two branches he applied the name Agathodaemon, and left the northern shorter one unnamed. This southern branch was last seen by him faintly in 1890, and by 1892 at Arequipa it had disappeared. Had he applied the name to the northern branch instead of to the southern one, it is probable that none of the subsequent confusion would have arisen.

Lying to the north of section (b) is a sharply curved canal uniting Maeisia to Messeis and sometimes extending south-westerly to Tithonius. Lowell in 1894 united this curved canal with section (a), under the name of Agathodaemon. Section (b) he called Coprates, and section (c) Daemon. Jarry-Desloges, in his map dated 1913, revives very faintly Schaparelli's southern branch, which he calls Agathodaemon. Section (a) including its northern branch, and half of the above mentioned curved canal he calls Coprates, and sections (b) and (c) Araxes II. The application of Roman numerals to Martian markings excepting as a temporary convenience, not for publication, is, I think, objectionable. For the northern curved canal the writer formerly suggested the name Kedron, and, since during the five past apparitions it has remained as a fairly conspicuous marking, it is proposed to retain that name for it. Excepting when section (c) is occasionally obscured by temporary cloud, the three sections of the main canal are always visible together. There thus seems to be no occasion for the added names Coprates, Daemon, and Araxes II.

It is accordingly proposed to return to Schiaparelli's original nomenclature, and call the three sections all taken together Agathodaemon. Should the short southern branch near Aurorae ever again appear, a new name will have to be found for it. It was never recorded by Lowell, nor ever seen by myself. The short canal stretching from Solis to Tithonius Lacus, Lowell also named Tithonius. It appears to me objectionable that two different objects in close proximity should have the same name, and especially so if we are going to omit the generic term. We have therefore adopted for this canal the name Calydon, suggested for it and published by M. Jarry-Desloges. The name Nectar we have applied in our survey to the extremely narrow canal joining Solis to the Mare preceding it. It seems to be the nucleus of the wider Nectar, which we have known in former apparitions as well as for part of the time in the present one. Its continuation through the thickened region to the following end of Solis we have numbered 12. Hamilton thought he saw two narrow canals parallel to it on either side, thus making a triple, but this has not been confirmed by others. Vitis

is a name given by Jarry-Desloges, and at this apparition it has been very prominent. Seven previously unnamed canals are shown and numbered. Owing to the objection to giving lakes the same names as the canals leading from them, two of Lowell's names for lakes have been discarded in favor of numbers, and seven new lakes in addition have been discovered and numbered, making 9 numbered lakes in all. Nakamura shows two small lakes on Bathys (Figure 30). One of them, No. 9, was seen by Lowell in 1909, the other was confirmed by

TABLE III.

CANALS VISIBLE IN 1924.

Name	Ab.	P	H	W	D	T	N	S	E	Tot.	P′	H′	L	J
Acampsis		+								1	+	+	+	
Acis	Ac.		+			+				2		+	+	
Aesis						+				1			+	+
Agathodaemon		+	+	+	+	+	+	+	+	8	+	+		
Ambrosia			+	+		+				3	+	+		
Araxes		+	+	+	+	+	+	+	+	8	+	+		
Baetis	Ba.	+	+			+	+		+	5	+	+		
Bathys		+	+	+	+	+	+	+	+	8	+	+		
Bradanus	Br.	+	+	+		+				4	+	+	+	
Caicus		+	+	+		+				4	+	+	+	
Calydon		+	+	+	+	+	+	+		7	+	+		
Cestrus	Ce.	+								1		+	+	
Chrysas				+		+			+	3		+	+	
Chrysorrhoas	Ch.		+	+	+	+		+		5		+		
Clitumnus	Cl.		+			+				2			+	
Eosphoros		+	+	+	+	+	+	+	+	8	+	+		
Eumenides	Eu.	+			+	+				3	+	+		
Garrhuenus	Ga.		+	+	+	+	+			5	+	+		
Helorus		+	+							2	+	+	+	
Hyscus										0			+	+
Kedron		+	+	+	+	+	+			6	+	+		
Krith	Kr.									0	+	+	+	
Namades						+				1		+	+	
Nectar		+	+	+	+	+	+	+	+	8	+	+		
Phasis			+	+	+				+	4		+		
Pyriphlegethon	Py.		+	+		+		+		4	+	+		
Ulysses							+			1		+	+	
Vitis		+	+		+	+	+	+	+	7	+	+		
11						+				1	+	+		
12		+	+			+				3	+	+		
13		+		+						2		+		
14		+	+							2		+	+	
15			+						+	2			+	
16		+								1			+	
17		+	+				+			3		+		
		20	23	16	12	23	12	9	10	35				

no one else, and therefore by our rules was omitted. He also shows one just to the north of Pnyx, which is not confirmed in that position, and is not far enough north to be identical with one shown on Antoniadi's map. Ten degrees of latitude is equivalent to 368 miles, or 592 kilometers, which will furnish a scale for the map.

In Tables III and IV following the name of the canal or lake, the second column gives the abbreviation by which it is designated upon the map, in case there is not room to print its name in full. The eight

following columns headed by the initials of the observers are arranged as in our previous Reports in the order of the longitudes of their stations. Each column indicates which canals were shown by the observer on his two drawings published in Report No. **34**, or in this Report. For Professor Douglass's drawing of region **C** which we have used here, a maximum aperture of 14 inches was employed. His other drawing, region **B**, could not be used, since its central meridian was too far from the required longitude, 60°, to be of any use for this purpose. The eleventh column gives the total number of observers who saw each canal, and it may thus be considered as showing the canal's relative visibility. The twelfth and thirteenth columns show all the canals in this region that were seen here in Mandeville, by the two observers,

TABLE IV.

LAKES VISIBLE IN 1924.

Name	Ab.	P	H	W	D	T	N	S	E	Tot.	P′	H′	L	J
Juventae S.		+	+		+	+	+		+	6	+	+		
Maeisia	MA.	+	+	+	+	+	+		+	7	+	+		
Pegasus	PG.		+	+		+				3	+	+		
Petelinus	PT.		+							1		+	+	+
Phoenicis	PH.	+	+	+	+	+	+		+	7	+	+		
Pnyx	PN.	+		+		+	+			4			+	+
Tithonius		+	+			+	+		+	5	+	+		
1		+	+	+		+				4	+	+		
2		+	+			+				3	+	+		
3		+	+		+	+				4	+	+		
4		+	+		+	+				4	+	+		
5		+	+			+				3	+	+		
6		+	+							2		+	+	
7		+	+			+				3	+	+		
8		+	+			+				3	+	+	+	
9							+			1			+	
		13	14	5	5	13	6	0	4	16				

during the months of July, August, and September. Krith was seen a number of times, but does not appear on any of the published drawings. Since three observers saw it however, it is entered on the map. Mr. Hamilton made a special study of this region, and in all his drawings taken together shows 32 confirmed canals out of a possible 35, as against 23 shown in his two published drawings. The two remaining columns refer to observations by Dr. Lowell and M. Jarry-Desloges. They do not indicate however by any means all the canals that these drawings and maps contain, but serve merely to confirm those canals and lakes which otherwise were seen by comparatively few observers. The totals at the bottoms of the columns of both Tables III and IV, curiously enough, serve to divide the observers into two groups, the three who used the larger refractors and the five who used reflectors.

DRAWINGS BY OTHER OBSERVERS.

Fifteen drawings of this formation by eight different observers have now been published in this report and its predecessor. Owing to the general interest in Mars which was aroused at this close apparition, it

was believed that others would be willing to contribute, and in response to requests in several cases, six other drawings of this particular formation have been secured, four of them representing the work of some of the largest telescopes in the world. Especial stress is laid on the size of the telescope, since some sidereal astronomers, particularly on the continent of Europe, still believe that these large instruments are the only ones capable of giving really reliable representations of the planetary surfaces.

Looking now at the canals only, and excluding the coarser Nectar, which of course everybody saw, we find 15 of them lying within the region of Thaumasia south of Agathodaemon and Araxes. Of these 15 Pickering shows 9, Hamilton 10, Wilson 4, and Trumpler 7 on their drawings in Report No. **34**. In the present report Douglass shows 5, Nakamura and Schofield each 4. and Ellison 5. Four of these canals were distinctly more visible than any of the others, as is shown by Table III, column 11, and were seen by nearly all of the observers. They are Bathys visibility 8, Calydon 7, Eosphoros 8, and Vitis 7. This group of comparatively conspicuous canals we will select as a test of the remaining drawings, not of their quality, for that depends on the skill of the artist, but as a test simply of the visibility of the finer details which their observers were capable of detecting at this close apparition. The observer who holds the record of observing all four canals with the smallest aperture is Nakamura with his 7-inch Zeiss refractor (Figure 30).

Our first additional drawing is by our fellow member the Rev. T. E. R. Phillips. He feels that little of value can be done on Mars in his latitude, 51°, when the planet is south of the equator, but we hope to hear from him later, now that the planet is again moving northerly. As it is he succeeded in showing three of the four canals with an 8-inch lens (M. N. 1924, **85**, 179). Our next drawing is one by M. M. du Martheray of Geneva, Switzerland, with a 5.5-inch French refractor. (*Bulletin Soc. Astron. Flammarion Genève,* 1925, **1**, 3). He shows the same three canals. His drawings may be compared also with Figures 32 and 36 by Ellison, with a 12-inch reflector. Both of them saw and represented Bathys and Eosphoros satisfactorily, but one saw Calydon and the other Vitis, these being, as we have seen, the two more difficult ones of the four.

As representative of the first of the larger instruments, a number of drawings were sent me by Professor Menzel made with the 20-inch refractor of the Chamberlin Observatory at Denver. They have now been returned to him at his request, but rather to my surprise but little was shown upon them, considering the excellent locality of the observatory. There may have been one or two out of the four canals visible. Our next figure is by Dr. Steavenson, the present Director of the Mars Section of the British Astronomical Association. The drawing was made with the 28-inch refractor of the Greenwich Observatory, the largest instrument of its kind in the British Empire (*Greenwich Obs.,* 1924,

C 4). Dr. Steavenson is known by his previous drawings to have acute eyesight, and the instrument used should be a good one. He states that the aperture was usually cut down by diaphragms to from 20 to 15 inches, in order to secure steadier definition, and reduce the illumination, although the full aperture was also used. He saw none of the four canals, but he did see Juventae S, which as shown by Table IV is equally difficult,—at least for small apertures. Had he reduced his aperture to 8 or 10 inches, it is possible that some of the canals would have been seen, since Mr. Phillips, located but a few miles south of London, saw as we have just seen, three of them with an 8-inch refractor. Dr. Steavenson's drawing was made rather late in the year, on September 24, which puts him at a disadvantage, but Mr. Phillips made one on September 17, not shown here, which shows clearly at least two of the canals. Here in Jamaica we saw five canals in this region on November 1, and two on December 11, when the diameter of the planet was reduced to 9″.7.

Our next drawing is by M. F. Baldet of the observatory of Meudon, using the great 32-inch refractor of that institution, the largest telescope of its kind in Europe, and also therefore the largest in the Eastern Hemisphere (*L'Astronomie* 1925, **39**, 33). He saw 15 lakes, of which our observers confirmed 12, but when it came to the selected canals he saw only 3 of them—the same ones that were seen by Mr. Ellison. His drawing implies that large apertures, when well situated, are suited to seeing the Martian lakes. On the other hand it appears that as far as canal observation is concerned, the larger instrument, located where it was, was inferior to the two smaller ones used in Japan.

We now come to a drawing by Dr. Van Biesbroeck made with the 40-inch telescope of the Yerkes Observatory—the largest refractor in the world, but diaphragmed down in this case to 30-inches—and furnished by the kindness of the Director. He too saw a considerable number of lakes, 7 of which we have confirmed, but only two of the four canals that we can certainly identify, namely Bathys and Eosphoros. These are the two easier ones, which all eight of our observers saw. They appeared to him so wide that we should hardly recognize them as canals. Indeed he himself says in *Ciel et Terre*, 1924, Nov., Dec., p. 276, (translation) "Neither now nor at any other time in the course of the present opposition, have I been able to convince myself of the presence on Mars of anything resembling the famous canals, that geometrical network with which certain observers have so generously decorated the soil of our neighboring planet." Of course he shows Nectar, Agathodaemon, and Araxes, which have always heretofore been called canals, and since the days of Schiaparelli have been so designated upon all maps of this region. He saw no trace of Baetis which was very easy this year, and was seen by 5 of our observers. Without doubt his eyesight is excellent, and he saw about what we should have expected, but had he diaphragmed his lens down to ten inches instead of thirty it is probable that he would have seen more.

Our last drawing was made by Mr. Pease with the great 100-inch reflector of the Mount Wilson Observatory, the largest telescope in the world, and was kindly furnished me by the Director. The low latitude of his station, +34°, gave Mr. Pease a great advantage over all the European observers, whose most southern station at Geneva, is in latitude +46°. His drawing and his description of what he saw is therefore of particular interest. He says "On the nights of July 27 and 28, and again on August 25, the region of Solis Lacus was in a position suitable for observation." August 25 was only two days after the opposition, when the planet was nearer to us than it had been for over a hundred years. It is also the season of the very best seeing for northern observers, so that every condition seems to have been favorable to a fine view in this southern latitude of the most delicate detail. Mr. Pease succeeded nevertheless in seeing only two out of the four selected conspicuous canals, Vitis and Eosphoros. Oddly enough however, perhaps by accident, he also recorded number 13, one of the moderately difficult ones, which was seen nowhere else at this apparition outside of Jamaica, although drawn here on several nights by both Hamilton and myself, and seen by Lowell in 1909. A comparison of Pease's drawing with those of Nakamura (Figure 30), Schofield (Figure 31), and Du Martheray (Figure 52) also makes it clear that he saw distinctly less than either of these observers who were limited to telescopes of 7, 8.5 and 5.5 inches aperture. He saw oddly enough very few lakes as compared with M. Baldet—only 5 that we could identify.

He remarks, "The moments of better seeing showed it (Solis Lacus) resolved into three balloon shaped markings or sinuses. * * * These markings and their connections showed a most exquisite mottling in light and shade, the pattern or blocking itself being irregular in shape and size." These singular balloon shaped sinuses which he was able to see for only a portion of the time, when viewed under the favorable conditions existing in Jamaica, resolved themselves into four very commonplace little lakes, two of which Mr. Pease saw as one. These lakes, numbers 5, 6, 7, and 8 of Table IV, were all of them seen by at least three different observers, and are similarly represented in their drawings (see Report No. **34**). What he means precisely by the "exquisite mottling in light and shade" I do not know. The darker areas simply presented their usual uniform shading, except where a lake occurred or a canal crossed them.

That the Mount Wilson telescope is admirably adapted to delicate photographic work, we know from the very beautiful pictures of the moon taken by Ritchey. Dr. Hale, and Mr. Pease himself more recently, have also secured photographs of Mars of the highest excellence. This is probably on account of the short exposures possible, because of the great light gathering power of the instrument. These photographs are indeed so good as to be nearly if not quite equal in definition to Mr. Pease's drawing. This is not the case with smaller telescopes, for instance at the Lowell Observatory, where the photographs are possibly

as good as those taken at Mount Wilson, while the drawings are infinitely better. This at once raises the question whether the quality of Mr. Pease's drawing is entirely explained by the great aperture of the instrument.

Evidence bearing on this question is furnished in the same article by Mr. Pease himself, which is illustrated by his drawing (*Pub. Astr. Soc. Pac.* 1924, **36**, 346). He there states that he is wholly unable to see a very obvious lunar test object, and thought he saw something entirely different in its place. He seems even to have thought that the object I mentioned did not exist. Now it so happens that a few years ago I received a letter from Dr. Hale, in which in referring to a much more difficult test, the dividing of the double canal inside of the lunar crater Aristillus, he wrote that with the 100-inch he could see it very clearly. This proves conclusively that the telescope can do good visual work. This same canal has been divided by Nakamura at Kyoto with his 7-inch refractor.

While the 100-inch telescope is clearly too large to show the finest planetary detail, or to add anything whatever to our visual knowledge of Mars, yet on account of its southern latitude, and the undoubted excellence of the seeing on Mount Wilson, we hope that some other observer, possibly a local artist, as well as Mr. Pease, will make some drawings with it at the coming apparition, and that these drawings will be published. There seems to be no reason why the 100-inch on Mount Wilson, if properly used, should not give as good results as Douglass's Brashear reflector, in the same latitude in Tucson. The telescope has established such a fine reputation for itself in lunar and planetary, as well as in stellar photography, that it seems only fair to Ritchey, its maker, as well as a pity on general principles, not to give it visually another chance. Mr. Pease of course did as well as the other observers with large telescopes. It is merely on account of his low southern latitude and good seeing, together with the excellent photographs that he and others have secured with the 100-inch, that we should have expected him to secure better results.

The results of this last investigation are summarized in Table V, where the third column indicates whether the instrument employed was furnished with a lens or a mirror, the fourth gives the date of the drawing, the fifth the aperture of the telescope, and the sixth the size of the diaphragm employed. The next four columns indicate which of the four canals were detected, and the last the number of them shown. It will be recalled that Eosphoros and Bathys were seen by 8 of our observers, Vitis and Calydon by 7. None of the large telescopes showed this last, and only two showed Bathys. In this test of giant telescopes it will be seen by this column that Meudon came off the best, and detected the most fine detail. It also incidentally scored in the total number of confirmed lakes that were seen with it. In this matter in fact it nearly equalled the 36-inch Lick telescope which showed 13, but it was hardly in the same class with the Lick in the matter of fine detail,

as indicated by the number of canals recorded (see also Table III). The mistake made by the two observers who diaphragmed their lenses was that they used much too large diaphragms. We should hardly expect that diaphragms of that size would produce any noticeable effect whatever.

In case some of my readers may think that I have been unduly severe in my criticism of the work of these observers, I may say that there are still many sidereal astronomers, some of these observers among them, who evidently believe that better work can be done on the planets by sidereal astronomers working with large apertures, than by the planetary astronomers themselves, who work with smaller ones. Also some of these observers, with no experience of their own whatever, have expressed very definite doubt as to the reliability of the careful, conservative, and painstaking observations, of planetary observers who like Lowell have devoted anywhere from twenty to forty years of their

TABLE V.

IDENTIFICATION OF CERTAIN CANALS.

Observer	Observatory	Tel.	1924	Aper.	Dia.	Eos.	Bath	Vit.	Cal.	Tot
Phillips	Private	L	Aug. 12	8	8	+	+		+	3
Du Martheray	Private	M	Aug. 15	8	8	+	+		+	3
Steavenson	Greenwich	L	Sept. 24	28	20.15					0
Baldet	Meudon	L	Sept. 19	32	32	+	+	+		3
Van Biesbroeck	Yerkes	L	Aug. 24	40	30	+	+			2
Pease	Mt. Wilson	M	July 27,28	100	100	+		+		2

lives to these especial investigations. This past apparition of Mars appeared to me to be an unusually favorable occasion to settle the question whether the criticisms of the sidereal astronomers were justified. They spoke very plainly and forcibly in some cases about the work of their colleagues, and I trust that in my reply to them I have not exceeded the usages of good taste. I have endeavored to credit the drawings of all the observers, whether with large or small apertures, with all the canals and lakes that they show. In any case it has seemed to me that the facts should be generally known, not merely to the sidereal astronomers themselves, but to the intelligent public as well, many of whom would otherwise continue to believe that the larger the telescope, the better it will serve for every purpose.

And now a few words in closing with regard to why these great telescopes have not shown us more than they have. Our atmosphere puts a rigid limit on the defining power of any telescope for planetary detail. This limit is far more rigid than it is in the case of double stars. Thus a 20-inch objective with fair seeing will separate a distinctly closer double than a 10-inch one, but for planetary detail there is usually but little difference between them. With poor seeing a 5-inch telescope will show all the planetary detail that can be seen with one of the very largest size. With better seeing we can use a larger aperture to advantage, but even with the best seeing that we have in Jamaica it is doubtful if there would be any advantage gained by using a larger

PLATE XIII.

Fig. 51
Phillips 8-inch

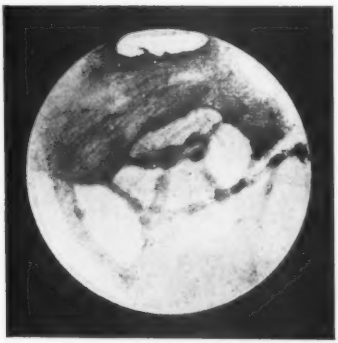


Fig. 52
Du Martheray 8-inch

Fig. 53
Steavenson 28-inch

Fig. 54
Baldet 32-inch

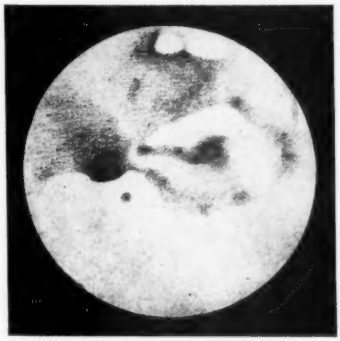


Fig. 55
Van Biesbroeck 40-inch

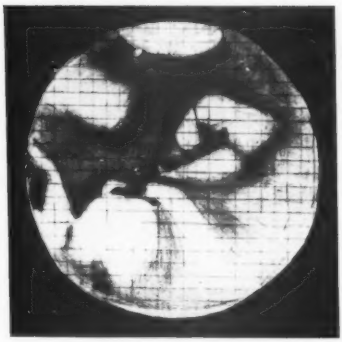


Fig. 56
Pease 100-inch

DRAWINGS OF MARS IN 1924.

aperture than 20 inches. Beyond the limit, the larger the aperture, the less can be seen with it. This is because poor seeing affects large apertures more than it does small ones, the explanation being that the large cylinder of rays joining the objective of the larger instrument to the planet will contain more than one crest and trough of the larger atmospheric waves which cause the poorest seeing, while the smaller cylinder of the smaller telescope will contain only a portion of one wave.

It may be well to give in this place a brief list of the observed dimensions of certain small objects which we are able to see or could detect under favorable conditions with a 10-inch aperture.

The diameter of the first diffraction ring, computed,	1".568
The diameter of a star disk according to Dawes,	0.456
The diameter of a bright star disk, H. A. **61**, 43	0.60
The diameter of a faint star disk, H. A. **61**, 43	0.35
An equal double which may be detected, Ellipticity 1.06, H. A. **82**, 40	0.23
A faint separating band visible, unpublished	0.50
Black parallel lines on white paper separated, H. A. **32**, 149	0.63
Bright points in a network of squares visible, unpublished	0.54
A black dot on a white background visible, P. A. **23**, 577	0.20
A black line on a white background visible, P. A. **23**, 577	0.03

The last two results are given in my Report No. **11**. It is because the finest lines are so much narrower than the smallest dots, that the good seeing secured with small apertures gives them an advantage over the larger ones in seeing the canals, while the lakes, regarding which the seeing is not so important, are better seen with the larger apertures. A measured human hair has been clearly seen with the 11-inch Harvard refractor at a distance a little short of a quarter of a mile. At this distance its diameter was only 0".029. A double star as close as that would be far beyond the range of our largest telescopes, even if the seeing were perfect. Owing therefore to the properties of light itself, a *fine canal under favorable atmospheric conditions is a far more delicate test for seeing with a given aperture, than the closest resolvable double star.*

We may quote here the interesting numerical results obtained by M. Jarry-Desloges, one of the leading European planetary observers. He has a 20-inch refractor, and has made a very extensive and elaborate study of diaphragms with it. He writes that he finds that at his observatory one should not usually use an aperture exceeding 14 inches, and that it should be capable of being stopped down to 8.5. Such a telescope he says would possess an advantage over others for planetary research in 95 to 98 cases out of 100. In the remaining 2 to 5 cases it would be inferior to an aperture of 20 inches but in at least 75 cases would be definitely superior to the larger instrument. His observatory is located in Algeria, and his drawings, and evidently his seeing also, are of the very highest grade (*Observations des Surfaces Planétaires*, VI, 340).

At the Lick Observatory the seeing is so excellent in the summer and early autumn, that somewhat I confess to my surprise, Dr. Trumpler

with the full aperture of the 36-inch lens saw about all that Mr. Hamilton and I could see here in Jamaica with our 11-inch. Indeed in some portions of the planet, notably in the desert regions north of Sabaeus he saw more, but in the snow cap less. Of course our aperture was altogether too small to do the best work on Mars. It is probable that if we could have increased it to 20 inches, and if he could have reduced his to the same figure, we should both of us have seen more than we actually did. There are as we have just seen still a few sidereal astronomers left who do not yet understand these simple astronomical principles, but excepting at the Lick Observatory, where we now know that it is distinctly worth while, it is obviously a sheer waste of money to use the time of a large and valuable telescope in attempting to do a kind of visual work for which it is wholly unsuited, and which can be done *much better* elsewhere with a cheaper instrument. This apparently is now well understood at the Yerkes Observatory, and also at Mount Wilson, where with the 100-inch reflector only one drawing of Martian detail was attempted, or at all events published.

The purpose for which very large telescopes are constructed at the present day is not well understood by the public. It is distinctly *not* to obtain better definition for the study of the moon and planets. For that purpose we now know that they are useless. The Yerkes telescope, those at Mount Wilson, and the great reflector at Victoria, B. C., were built expressly in order to gather at one point as much light as possible for the study of spectra, and of faint stars and nebulae. The last of these instruments I believe has never been used for any other purpose, and the others only rarely.

Although not applying so directly to Mount Wilson, another obvious handicap of the remaining three large telescopes just discussed, the Greenwich, Meudon, and especially the Yerkes, is that they lie in the great anticyclone belt of our planet. Within that belt the seeing never is, and never can be, at all comparable to what is usually found in certain more southern localities. In these latter the best planetary observations always have been, and always will be made, and it is of no use for other stations, no matter what their equipment, to try to compete with them. It is not at all a question of the observer, providing, of course, that he has the proper initiative, and if his eyesight is simply fairly good. Anyone with a reasonable amount of skill with the pencil, when suitably located, can make satisfactory drawings of the canals and lakes of Mars.

Private Observatory, Mandeville, Jamaica, B. W. I.
March 15, 1926.

ASTRONOMY AND GRAPHICS.

By FREDERIC R. HONEY.

At a certain stage of his study of Astronomy the student realizes that his training in Descriptive Geometry enables him to visualize phenomena which might otherwise be obscure. In the representation of the earth, for example, he naturally refers it to the plane of its orbit, which takes the place of "the horizontal plane of projection"; and to a plane which is perpendicular to its radius vector, which becomes "the vertical plane of projection."

On account of the great distance between the sun and the earth, a projection of the earth on a plane which is perpendicular to its radius vector is practically the same as a perspective drawing of the earth as seen from the sun, of course very highly magnified; that is to say, the two drawings would not sensibly differ.

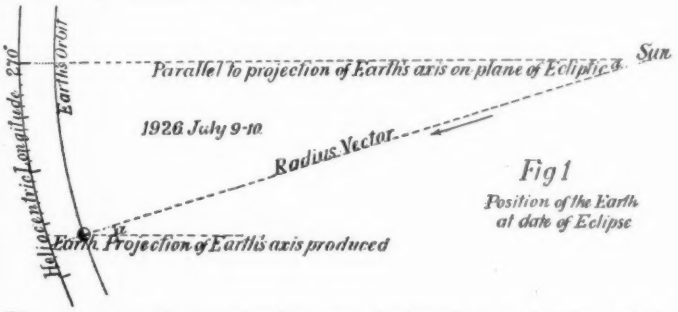


Fig 1

Position of the Earth at date of Eclipse

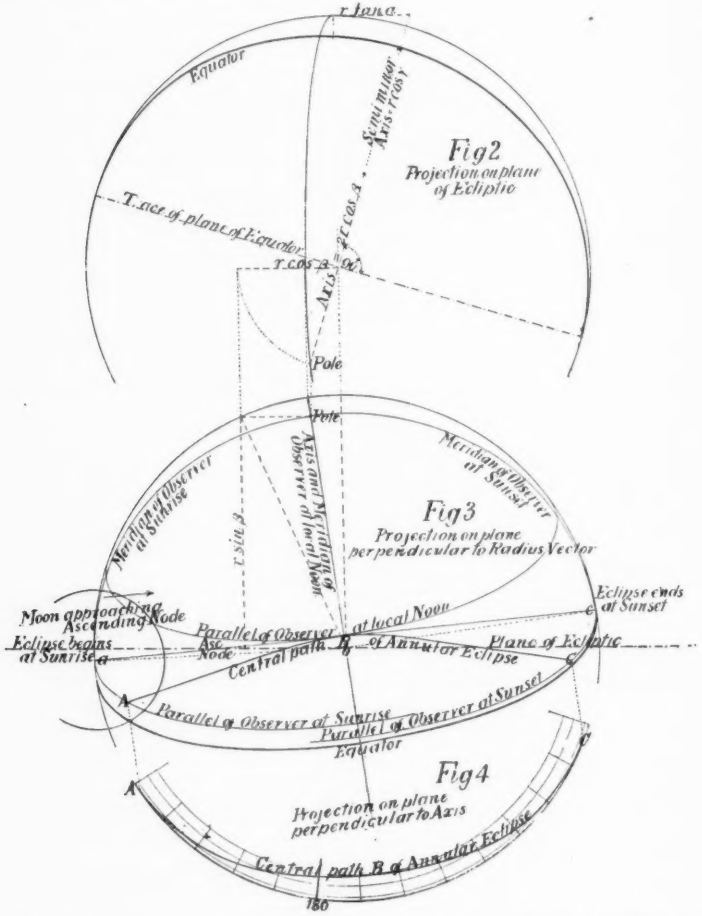
The accompanying projections are designed to assist the student in the interpretation of some of the "circumstances" of an eclipse; and the constructions in reaching the final result, *i. e.*, the path of the annulus, are indicated in detail. The example selected is the annular eclipse of July 9-10.

In a drawing of these dimensions the contour of the earth does not differ from that of a sphere, and is represented by a circle; and the radius of a parallel of latitude is made equal to that of the equator multiplied by the cosine of the latitude.

The position of the earth, whose heliocentric longitude at the date of the eclipse is 286° 57′, is shown at Fig. 1. The projection of the earth's axis on the plane of the ecliptic moves into positions which are parallel to its projection when the earth is in longitude 270°, that is at the date of the solstice, when the projection coincides with the radius vector. The angle $\alpha = 16° 57'$ $(286° 57' - 270°)$.

In the projection on the plane of the ecliptic (Fig. 2) the semi-minor axis of the ellipse representing the equator is equal to the earth's radius

multiplied by cos γ (23° 27′), the inclination of the plane of the equator to that of the ecliptic. In this figure, the projection of the earth's axis is inclined at the angle α to the radius vector, and is equal to its true length multiplied by cos β (66° 33′), the angle which the axis forms with the plane of the ecliptic.



Details of construction are explained in Figs. 2, 3, and 4. In addition to the ellipses representing the parallels of the observers at sunrise, local noon, and sunset, whose latitudes are respectively 4° 12′, 25° 36′, and 1° 27′, ellipses representing parallels whose latitudes are 10°, 15°, and 20°, should be constructed, which, with the assistance of Fig. 4, the projection on a plane perpendicular to the axis, will give additional

PLATE XIV.

Photograph of Moon.

January 26, 1926.
Upper Sunspot Group in Form of Footprint.

January 29, 1926.
Same Group Near West Limb of Sun.

PHOTOGRAPHS OF MOON AND SUN BY LATIMER J. WILSON WITH AN 11-INCH REFLECTOR WITHOUT DRIVING CLOCK.

points on the curve *ABC*. In order to avoid confusion in the drawing, already somewhat crowded with construction lines, these parallels are omitted.

The meridian of the observer at sunrise is an ellipse whose semi-major axis is the dotted line *oa* joining the center of the earth with *a*, the first point of observation; and the pole is a point on the curve. Also the meridian of the observer at sunset is an ellipse whose semi-major axis is *oc* joining the center with *c*, the last point of observation; and the pole is a point on the curve. With these data the ellipses may be completed by a wellknown construction.

The central path of the annulus which may be conceived as traced on the earth's surface in advance of the eclipse, is represented at the "date," *i. e.*, when it crosses the meridian at local noon; and Fig. 4, which should be plotted on a large scale, gives the positions of points on the curve relative to parallels and meridians, which correspond with those which are found in the path of the annular eclipse plotted in the *Nautical Almanac*.

Trinity College.

PHOTOGRAPHS WITH A REFLECTOR.

By LATIMER J. WILSON.

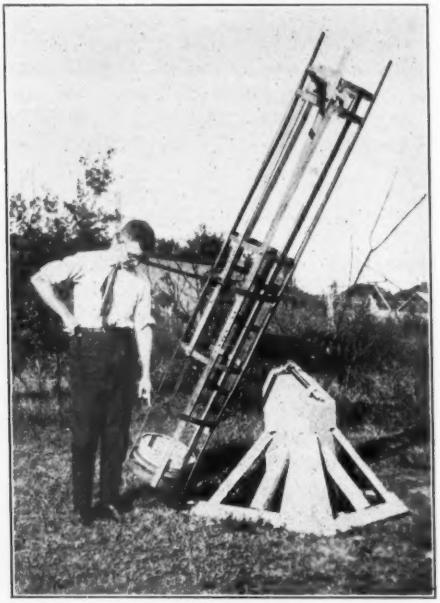
Considerable popular interest has recently been awakened in amateur astronomy relating to the making of one's own telescope. In a leading periodical has been published a lucid description of the stereotyped method of grinding and figuring a glass speculum by hand. The present writer has frequently published several articles on the same subject based on experience in having made three reflectors. Without claiming professional perfection for any of them, these telescopes have been a delight through the years in disclosing marvels of the heavens.

I first made a ten-inch mirror. Lacking information about the Foucault method of testing an optical surface, figuring was accomplished entirely by employment of the eyepiece and judging the curve merely by appearance of the expanded image of an artificial star inside and outside the focal plane. Then I succeeded in obtaining copies of papers by Dr. Henry Draper and G. W. Ritchey in *Smithsonian Contributions to Knowledge*, Vol. XXXIV, in which good descriptions of the Foucault test were given. It was necessary to continue the work of figuring until a parabola was obtained and this ten-inch mirror worked fairly well, giving clean star-disks. Unfortunately the glass was only ⅞ of an inch thick and consequently suffered flexure during temperature changes which interfered with satisfactory results at times. It was used through 1909 and until a twelve-inch disk 1½ inches thick had been completed in the spring of 1911.

The Foucault test enabled me to finish this telescope in about 148

hours, but at the very last I saw that the outer edge of the speculum was being flattened. To correct this defect it would have been necessary to go back to fine grinding and do the figuring all over again. As I desired to make observations of Mars that year, it was decided to reduce the aperture by a diaphragm, and I am still using this speculum as an excellent eleven-inch. A seven-inch speculum was also made and only about 48 hours were required for completion of the work.

I have found the eleven-inch telescope suitable for photography of the sun and moon. As the mounting is at present inferior, only rapid



Latimer J. Wilson's Reflecting Telescope for Photographing the Moon and Sun.

exposures can be employed for I have neither slow-motion nor driving clock. The focal image of the moon is about ⅞ inch in size, the focal length of the speculum being about 96 inches. It was desired to obtain some enlargement of this image on the negative to overcome the enlargement of silver grains in the emulsion when an image a foot or more in diameter was to be printed.

Without a driving clock or slow motion an exposure longer than one-fifth of a second is not satisfactory because of the moon's motion through the field. Consequently my pictures of the moon are by no means as sharp as they would be if the telescope could be used to follow the moon through the field. A double concave lens was placed between

the flat mirror and the plate at a distance to produce an image about three inches in diameter. Exposures of about one-fifth of a second gave fairly good results. Varying the distance of the negative lens varies the size of image.

Best results were obtained in photographing the sun by removing the silver from the surface of the speculum. Even then, with exposures of about 1/1000 of a second on process plates there was too much light, so the aperture was reduced to about seven inches. The state of atmosphere in sunlight made it difficult to obtain images as sharp as they otherwise would be.

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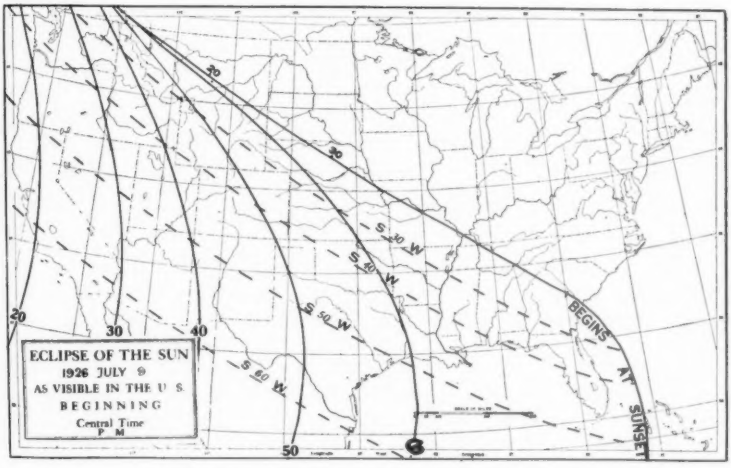
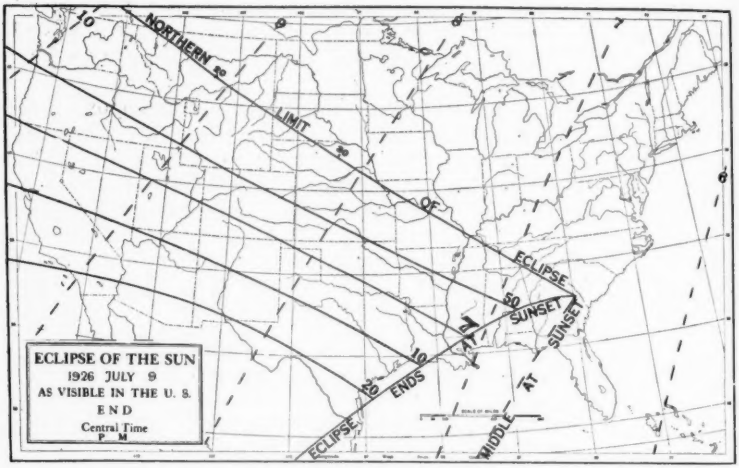
THE SOLAR ECLIPSE OF 1926, JULY 9.

By WILLIAM F. RIGGE.

The solar eclipse of 1926 July 9 will be visible only to the western and southern states, but even there the magnitude will not exceed 0.35. On the two annexed maps the full lines show the central times of the



beginning and ending respectively, the large 6 and 7 meaning 6 and 7 P. M. Central Time, and the smaller numbers 10 to 50 the following and preceding ten minutes. For the beginning the position angles are given by the broken lines from S 30 W to S 60 W. In Fig. 2 the lines marked 6, 7, 8, 9, 10, on the top, indicate the central times of sunset. No map



has been drawn for the middle of the eclipse. The magnitude may be estimated by comparing the distance of a place from the limit line in terms of that of the Lick Observatory on Mount Hamilton from it, where the magnitude is 0.3. The numbers 20 and 30 on the limit line are the minutes after 6 o'clock when the grazing contacts take place.

GRINDING, POLISHING, AND CORRECTING AN EIGHT-INCH LENS.

By LOREN S. NOBLITT*.

For years I tried to find a manual for making an objective for a refracting astronomical telescope but was unsuccessful in my search. I found many valuable helps; but in most cases the articles were only theory which was too difficult for an amateur to make practical. The best help obtained was from the description by Dr. Henry Draper, found in the *Scientific American Supplement* Nos. 1543-4, on the grinding and polishing of a fifteen and one-half-inch reflector. Indeed it is an indispensable requirement to know how to grind, polish and test a reflector before beginning a refractor. It will also be needless to emphasize the admonition that only those who have a mechanical turn of mind could hope to be successful in such a difficult undertaking. There will be many instances in which ingenuity combined with an abundance of patience is the only key to unlock the closed door.

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I decided upon grinding an eight-inch lens. This was not a sudden decision; there were several elements causing me to decide so. I wanted a lens that would do work beyond a good spyglass. Anyone knows that a one-inch objective with reasonably good definition will show many remarkable wonders of the heavens, such as the mountains on the moon, the satellites of Jupiter, and double stars. Furthermore, the smaller the lens the more difficult would be the testing, within reasonable limits. For an amateur to attempt even a four-inch objective would necessitate handling lenses with small apertures and short foci, which make it quite difficult for operation. With an eight-inch objective there will be radii which make the work comparatively easy if the principles are well known.

Calculation of Curves.

With this subject we face the first and perhaps the greatest preliminary preparation. A man of many years' experience might be able to guess at the curves, and by grinding and trying he might be able after much effort to produce a fair image. But the amateur cannot hope to do as much. When we know that an error of one-thousandth of an inch would utterly ruin an image we see how much depends on the proper curves.

By remarkable coincidences I became acquainted with a gentleman of great ability in theoretical optics, Dr. F. Kollmorgen, of the Kollmorgen Optical Company of Brooklyn. Through the great kindness of this gentleman I learned how to do my own calculation of curves. In accordance with the predictions of Dr. Kollmorgen, this became the source of great interest. Anyone who has had a little training in trigonometry, and who knows how to use logarithms can do his own calculations. I can not here give an extended account of these calculations—that is sufficient material for a paper. After about two weeks of hard work, using my spare time from teaching, I obtained excellent results. This process will give the exact radii properly corrected for color and for spherical aberration.

A rough estimate of the relations of the four radii to the entire focal length may be found from the following data: For the eight-inch objective the focal length of the entire system was chosen to be 3500 mm, or a ratio of one to seventeen with respect to the diameter of the lens and the focal length. Then the first radius was about three-fifths of the entire length, the second radius one-half the first; the third radius six mm longer than the second; and the fourth radius about twice as long as the first. This makes the crown lens double convex, and the flint lens concave convex.

It is significant to note that one surface will sometimes correct an error of another. It is also true in the calculation, that if it is necessary to change the length of a radius for correcting color the two inner radii are changed an equal amount; for correcting spherical aberration only the two radii of the flint lens are changed. The four radii as finally obtained by calculation were as follows, beginning with the

outer crown:

R_1.....2282 mm.
R_2.....1180 "
R_3.....1186 "
R_4.....4464 "

A very excellent paper on calculation of curves may be obtained from the Bureau of Standards, at Washington, D. C. (Letter Circular LC 67). As to the practical results obtained from such calculations I cannot say; but I speak from experience with respect to the method described. My lens gives very excellent satisfaction upon all objects observed.

I obtained my optical discs from Bausch and Lomb of Rochester, the two costing a trifle less than sixty dollars. The approximate thickness of each was one inch; and since the lenses must sustain their own weight when suspended from the edges the large ratio of thickness to diameter was desirable. Fortunately the distortion of the lenses from such weight does not affect the image as seriously as is the case in mounting a reflector. The strain produced upon one surface is partly corrected by a similar strain upon the companion surface.

Preparation of Tools.

The first process in the grinding of the lenses was to obtain parallel planes on my optical discs. When the latter were received from the factory the sides were rough and somewhat uneven. I obtained a flat piece of steel from a discarded machine to grind down the roughness from the discs. Using carborundum number seventy I sprinkled a thin coating over the top of the flat surface and sprayed a little water upon it to assist the evenness of the work. A very few minutes served to obtain a fairly flat surface on the disc. Having one side sufficiently plane I ground the other side in like manner, using at frequent intervals a micrometer at all points about the edge. With a little added pressure upon the portions that were thickest there was no difficulty in obtaining a uniformity of thickness well under one-thousandth of a centimeter. If this work is carefully done and the subsequent work is symmetrically followed out the optical axis of the lens will coincide with the center of the disc.

Since my radii had been obtained by calculation there was not much difficulty in making templets for each curve. Templets may be made of galvanized sheet iron which may be obtained from the tinsmith. I took two rectangular pieces of metal eight inches long and two inches wide and struck arcs on these using as a radius the length obtained by calculation. The first to be used was 2282 mm, but I made one edge of the metal convex and the edge of the other concave. After filing these very carefully I tried the two surfaces together to see how nearly the two curves were symmetrical. By holding the two between the eyes and a bright light the exact portion to be filed could be found. This process is very essential, for with these templets the curves of the tools are gauged.

Since there are three convex surfaces in my objective it was neces-

sary to have three sets of tools for grinding. For each convex surface it is necessary first to make a concave lens of the exact curvature desired for the convex surface. This we call a test plate, and may be made of ordinary plate glass about one inch in thickness.

My tools were made of cast iron about one-half inch thick with a one-inch projection in the center which was machined and threaded to attach a knob for holding. Usually the tool was worked *upon* the glass, but provision was also made for inverting the tool and working the glass on top. The castings and templets were given to a machinist to turn on a lathe to fit the templets. These did not come from the lathe with perfect curvatures; but by using fine grade carborundum about number eighty, with a spray of water, the two curves were ground together quite accurately. This could be detected by the polish of the tools where the carborundum was cutting.

In order to have the grinding material evenly distributed over the glass while grinding, it has been found advisable to cut grooves in the cast iron tools. This may be done with a file, making the groove at least a sixteenth of an inch wide and as deep, making one-inch squares over the entire surface of the tool.

In beginning the grinding of the test plate I did not first use the tool just described. Had I done so the central portion of the tool would have been flattened considerably before the proper curvature was reached. To effect the rough grinding I made a rough casting of lead about eight inches in diameter and about an inch thick. A few blows with a hammer made the tool sufficiently convex on the opposite side to begin grinding the optical disc. As the lead wore away the lead tool was again made more convex by a few more blows. A little experience with this method, together with frequent testings by the templet will add much efficiency. When the templet fits quite well the machined tool may be put on without fear of changing the curvature. The rough grinding may be done with coarse carborundum such as thirty or forty; but the grinding with the machined tool should not be done with any coarser material than seventy or eighty.

A symmetrical surface can not be obtained at a table. The proper bench for holding the glass while it is being ground is an isolated post, quite firmly placed so as to give little vibration. This may be done by taking a piece of two-inch pipe thirty-two inches long and after threading both ends, screw on two floor flanges. One end may be secured firmly to the floor by lug screws, while to the other end may be attached a firm block about one-foot square. This will make the stand about thirty-four inches high, and will permit access from all angles.

Too much stress can not be placed upon the symmetrical figure of the curves being produced. From the very beginning of the grinding until the last stroke there must be an equal distribution of activity upon the surface of the lens. This is best obtained by constantly moving about the stand. In grinding the first test-plate, which is of course concave, the lead tool is moved across the center of the disc. As soon as this is

done the feet are moved a few inches so that the next stroke traverses another diameter of the disc. The constant movement about the stand will develop a beautiful figure.

The glass may be held very advantageously by securing it upon one of the cast iron tools. To do this heat the tool in hot water or by an alcohol lamp and drop a few drops of melted pitch upon the surface. While the pitch is still soft apply the glass to the surface, the glass itself having been heated in warm water. The glass may be removed without difficulty by giving the iron a few light blows with a hammer to loosen the pitch.

In using carborundum sprinkle a small pinch mainly over the central portion of the glass and spray enough water upon it to allow it to work well. With the lead tool this will do good cutting for about two minutes. There is nothing gained by continuing to grind after the carborundum has become pulverized. Before applying another quantity wipe off with a damp rag or sponge the thick coat of stiff mixture, since it will hinder the cutting of the next application. I saved the surplus grindings by rinsing the rag in a container. By this means I could make my own siftings for the fine grinding. However, the various grades of carborundum may be bought in pound or half-pound boxes. Sifting may be done by thoroughly mixing the mud in a tall jar filled with water and perhaps a handful of the mud. After waiting for twenty seconds siphon off the upper third of the contents and mark it as such. After this has settled for five minutes or more it may be decanted so as to keep only the sifting which has settled. In like manner make a one-minute, two-minute, five-minute, ten-minute, twenty-minute, and thirty-minute sifting, carefully labeling each jar.

In changing grades too much care can not be taken. Do not change too soon. The first few grindings of one grade will smooth the top of the surface; but unless the deep pits of the coarser grinding are removed they will show up to your chagrin when the polishing begins. To make sure of this, I used a magnifying glass to observe the surface frequently. Of course, scratches may be seen without the aid of a magnifying glass, and must be eliminated, not so much because of the final image, as for your own satisfaction. Usually there will be some scratches appearing during the polishing unless great care is taken.

Testing Focal Length.

In order that much work may not be wasted it is well to test the focal length of the test plate before completing the fine grinding. After using the two-minute grade of powder I put a very slight polish on the glass, sufficient to give a dim reflection from a lamp. Using a polishing tool perhaps two inches in diameter, described later, with polishing rouge I worked it over the lens passing over every possible chord for about five minutes. Knowing what the radius of curvature was I set up the test plate about that distance away from a light surrounded by an opaque screen in which had been punched a small hole perhaps one-

sixteenth of an inch in diameter. The light must be arranged so that the image of the pinhole will be reflected to a point near the side of the light but a little behind it. This will permit its being seen without difficulty. Then using a knife-edge, Foucault's test can be made upon the lens. Measure the distances from the pinhole to the center of the lens, and from the knife edge to the lens; the average will be the focal length. This will tell whether the lens needs to be ground deeper, or made shallower by grinding about the outer portion. Here you must use your own judgment for results. I found no very great difficulty in obtaining results within one millimeter of the focal length desired.

The best description of Foucault's knife edge test to be found is doubtless that given by Dr. Henry Draper, which was published in the *Scientific American Supplement* numbers 1543-4, and may be found in any good library.

Adjusting the Focal Length of the Tools.

If upon testing the test plate you find the focus is too long, grind the two tools together with the convex tool fixed underneath, working the concave tool over it in a circular motion, keeping the central portion of the upper over the circumference of the lower. This will grind the lower more convex and the upper more concave. Keeping in mind that a very little grinding will change the radius of curvature several millimeters you should quickly adjust the curvature.

After the proper correction has been made, the fine grinding may be continued, since the amount of change produced on one side by the fine grinding, if carefully done, will not destroy the radius of curvature desired.

In grinding the optical glass better results will be obtained by grinding both sides with the coarser emery before fine grinding or polishing either side. The strain produced on one side by removing a large amount of material from the other side may change the curvature slightly; but the fine grinding will remedy this.

Polishing.

Polishing tools may be made by using the grinding tools. I have obtained fair results by using rosin softened by adding turpentine until an indentation may be made with the thumb nail when the mixture is cool. Many people prefer to use pitch softened with beeswax. Apply the mixture while hot, having previously heated the tool to cause the pitch to adhere. Place over the glass a piece of clean paper and press the tool against the paper for a few minutes. To remove the paper apply cold water and with a sudden jerk it may be removed. Reheat and apply again if a smooth surface is not obtained. When cool cut grooves about one-fourth inch wide covering the entire surface with blocks about one inch square. This distributes the polishing material evenly. Before using, spread a thin coat of rouge over the surface of the glass; then heat the pitch slightly and press it upon the glass. The

rouge will keep the pitch from adhering to the glass. This will give an excellent surface for polishing.

Newton's Rings.

After polishing the test plate and correcting its errors by means of Foucault's knife edge test I proceeded to grind and polish the first surface of the crown glass. A fair polish was obtained in about two hours. Then wiping very carefully both the test plate and the surface to be tested I placed the one upon the other. Wherever the two plates touch will be seen the colors of the rainbow when observed at the proper angle and by a good light such as a window. The stronger these colors, the more nearly the two surfaces coincide. Polishing these points will bring the two surfaces to have the same curvature. When they coincide well the color will be evenly distributed over the entire surface, and no sharp bands of color on any portion. All this correction must be done symmetrically to preserve the shape of the image.

Polishing Tools.

While a polishing tool the full size of the glass is necessary for an even polish, smaller sizes are quite advantageous for local defects. I have a set of tools composed of six in the set, ranging from the full size of the lens to one that is one-half inch in diameter. They are all made after the general manner described as far as the hardness of the pitch is concerned. They may be made of wood; and they give better satisfaction if the block is sawed from a beam so that the pitch may be applied to the surface showing the rings of growth. It is very necessary to cut grooves in each one for distributing the material.

Usually the defects in the surface will appear in zones rather than in spots. It may be more effective to correct such with a local polisher. The action should be in straight lines which are chords passing over the zone of disturbance. Continual movement about the lens is necessary to produce symmetry.

After polishing vigorously for a few minutes the glass will be heated unevenly and must be allowed to cool for a few minutes before testing, otherwise the test will be misleading. I have had instances where I was polishing to reduce a high zone; and because of testing too soon I polished again for the same defect; when if I had waited until the lens had cooled I should have found the zone already corrected. Such a result is very troublesome and necessitates the polishing of the entire surface again.

The very best grade of rouge should be used. This may be purchased from many opticians or from such houses as Bausch and Lomb Optical Company, Rochester, New York. Some rouge has much quartz, which may be advantageous for scouring metal plates; but such ingredients would hinder good work on a lens. The rouge may be sifted in much the same manner as carborundum. Mix three or four tablespoonfuls of rouge in a tall vessel filled with water. In two or three minutes the

water will be clear. Siphon off the water and the upper layer of rouge. What is left may be used for rough work.

Correcting the System.

After the four surfaces are polished and corrected by means of the study of Newton's rings the whole system must be corrected by means of the knife edge test. The two lenses must be put together as a single objective and tested by a bright point of light several hundred yards away so that it acts as a star.

It is advisable to have at hand the cell for holding the objective. I had my casting made of aluminum, and turned on a lathe leaving a shoulder against which the lens would rest. A ring was turned to fit the other end of the cell to hold the lens in place.

As the two inner curves had different radii the lenses touched in the central parts but not at the circumferences. I took three small pieces of tinfoil and placed them about the circumferences of one lens and placed the other upon it so that the weight was borne by the three points. This has given very good satisfaction.

It is very necessary to test the cone of light in the line of the optical axis. Even a slight variance from this will hinder the best results. For this reason it is well to have a tube to which the lens may be attached and adjusted for testing.

The first correcting may be done in the daytime by the use of the sun. About four hundred yards away I placed a convex reflector, such as is used in a physics class for demonstration, which acted as an artificial star. Being of a short radius it would serve for several hours without being adjusted. The heat waves will interfere for the finer corrections but the first work may be done in this manner.

Place the knife-edge at the focus, but instead of placing the eye on the left side of the knife edge place it on the right. In other words, let the knife edge approach the cone of light from the left instead of the right as described in Dr. Draper's excellent article on reflectors. I learned this by making an annoying mistake because I read the surface defects in the wrong manner. I found that if I used the knife edge test on the refractor as for a reflector, the apparent low portions of the surface appeared as high places and vice versa. In trying to correct an apparent high zone near the center of the system I polished for several hours not knowing I was scooping out a deep zone which could only be overcome by regrinding with two or three grades of emery. But by interchanging the positions of the knife-edge and the eye the true defects could be seen.

Fortunately correcting the entire system does not mean correcting each surface again. When the lens is tested as a whole the imperfections may be clearly studied, but the polishing is done only on the fourth surface. This surface having the longest radius of curvature will permit results m quickly than the others. This is true when the four surfaces are f corrected within reasonable limits by Newton's rings.

Since a few minutes' polishing may utterly ruin a good image it is very necessary that the final correcting be done with great care. The work on my eight-inch lens was done during the summer months and the heat waves were the source of much inconvenience. No careful study of the surface could be made when the whole lens appeared as if tongues of fire were rolling over it, so I tried various hours for better results. The best time was found to be about three o'clock in the morning. While it was not the pleasantest task to arise so early and walk eight hundred yards to light my star, yet keen interest in results spurred me on. This final correction took me several weeks for completion; but the results were gratifying. This was being done while Mars was approaching very near the earth; and one of the first tests made with the lens on heavenly objects showed the snow cap of that planet.

A PUZZLE IN PARABOLOIDS.

By B. F. GILLMOR.

The following letter was received from an enthusiastic telescope maker, a man earnestly struggling to extend alone and for himself his intellectual horizon. His letter presents many knotty difficulties. Any amateur telescope maker who has been through the experiences this earnest worker is struggling with will understand his trials. A few will attempt, perhaps, a solution of the problems it contains. To the average reader there will be humor in it. To the higher minded person there is something appealing and pathetic in the lonesome struggle that many men must carry on for the improvement of a mind. This letter is thus in its way a document and is therefore published just as written, with the consent of its writer.

Anything that can be added to the solution of its problems as contained in the "answer" will be gratefully received by everybody concerned. In the meantime, those of the amateur telescope makers who enjoy cross-word puzzles may try their hands at this puzzle in paraboloids.

THE LETTER.

Dear Sir;—

I note your wooden telescope in October number 1925 popular Astronomy which I take.

I building two 10" reflector have one in tube working but I haveing little trouble in defination Jupiter rings or word belts was very pail just could see them it true I was useing my merror was finish as spheroid I had tryed to sink middle little with my finger.

sence I have tryed to Paraboloid with circler stroke cross one half on wax. test on star make flare alround star just as you looking at sun with necked eye. like this *[1] but longer wonder if I got it two deep other word paraboloid two long. I trying make test with small pin hole with very small lamp the light show glass something like life saver with central hole fill in. I have not had chance to get

[1] Diagram of star with flares.

glimp of jupiter sence I paraboloid. do not know how belts will show up or would they show up better if earth and jupiter both on same side of sun.?

I have glass other words all merror well centered I have never see a star in first class telescope it a true ball light with out any flares when I look at them with glass finish as spheroid as I say when I tryed to paraboloid then star look like this. *[2] if paraboloid proptly did should a star not be true ball light? I get good rings just little out focus. but I do not like look star in true focus. I started these glass from what I got Mr Barns had instructions.

I would appriacete so very much would give me little informaton on this as I work hard over these merrors and have tubes and mounting all finsh with finders on tubes one glass 69 inch focus other is 89 inch focus both 10" merrors. well ground true and well polish no sratches just haveing troubleing in figureing when I first stared to paraboloing a lump showed up in center I keep on working outer edge wax until this left this look like made it center little deep. the roll edge short. I nothing but telegraph Operator but like every thing in astronomy where do you get your brass tubeing from?

hope you not think hard of me asking you for this imformation. but I feel asure you can help a fellor out hole to get these two 10" proper paraboloid. with good defanation.

THE ANSWER.

The rings of Saturn should be visible in your 10-inch reflector. The belts of Jupiter will be faint, owing to too great brilliancy of the image. Stop your tube down to 6½ or 7 inches and the belts will be plain, if the mirror is correct.

The description of your troubles leads me to believe that you have over-parabolized by cutting the center too deep. Either make a new polishing lap or build up this one you have—if the squares are unaltered—with melted beeswax applied with a brush so that the peripheral parts will cut the most and thus bring the figure back to spherical with the polisher. Then parabolize carefully with the outer squares trimmed down; or you can continue cutting back the rim and get your parabola that way.

The main thing is to avoid over-parabolizing. A sphere is hard to get and to keep as you polish. You will have to watch your progress with the knife edge test as you go along.

Block out the rim and get the focus of the center part of your glass; then block out the center and take the focus of the outer inch or so. For a correct parabola for your 69-inch glass the rim should be a trifle less than 1/6 inch longer focus than the center—using the central 2½ inches of the mirror. Find these foci with the knife edge test.

The probabilities are you will save time by making a new polishing lap, as the old one will continue to cut as before and will only increase the error.

The first speculum I made I found had a rim of 1½ in. longer focus than the center—testing from the center of curvature, as all these tests are made. I had to re-grind it.

The appearance of the glass as merely an illuminated disc with the pin hole test is not reliable. The appearance as of a life-saver candy as described by Porter in the *Scientific American* of Feb., 1926, refers to

[2] Diagram of star image with bright rays about it.

the appearance at the moment the knife edge crosses the focus—just as the light is being extinguished.

With the knife moving *to* the right the interpretation of appearance of the surface is as though the mirror were illuminated *from* the right and is simply a method of remembering how the Foucault test appears with different figures.

Winter seeing is not good enough for real testing of a glass. Jupiter is too bright, also, with full ten-inch aperture to show the belts well, or even fairly well, with a short focus mirror. Stop it down to 7 inches and it will do better for planetary detail. Keep on trying the instrument night after night and you will learn a great deal about both your telescope and seeing conditions.

A short focus reflector does not show a bright star as an apparent ball of light. With perfect atmospheric conditions and even a long focus mirror it will still show the flares or rays due to the support bands of the diagonal. With a short focus mirror only the fainter stars are without bright rays about them. The full aperture should be reserved for fainter objects. Have a set of tin or cardboard diaphragms ready and use as required.

The true paraboloid can be determined (with ordinary amateur equipment) only by the behavior of the out-of-focus rings of a not too bright star on a steady, suitable night (see Bell's "The Telescope").

Mr. Barns' instructions in *Science and Invention,* Dec., 1922, and Jan., 1923, are easy to follow; but he failed to mention that laying on of hot wax tends to build up the outer parts of the polisher. Your paraboloid may be due, if you finished that way, to the rim being cut back too far. If so, you could bring to a correct paraboloid by trimming down the outer squares and polishing back to a true sphere and thence to a paraboloid again by cutting the center. The difficulty is to determine whether center or rimcutting has made the paraboloid you have. When in doubt, build up the outer part of the polisher, cut back the rim to a paraboloid; then cut the peripheral squares down and bring to true figure as above.

You will have to test frequently with the Foucault test to know what you are doing and without frequent tests as you go along you will never get anywhere in the art of figuring.

If the pitch is too hard you will never get a good figure, but will always over-parabolize.

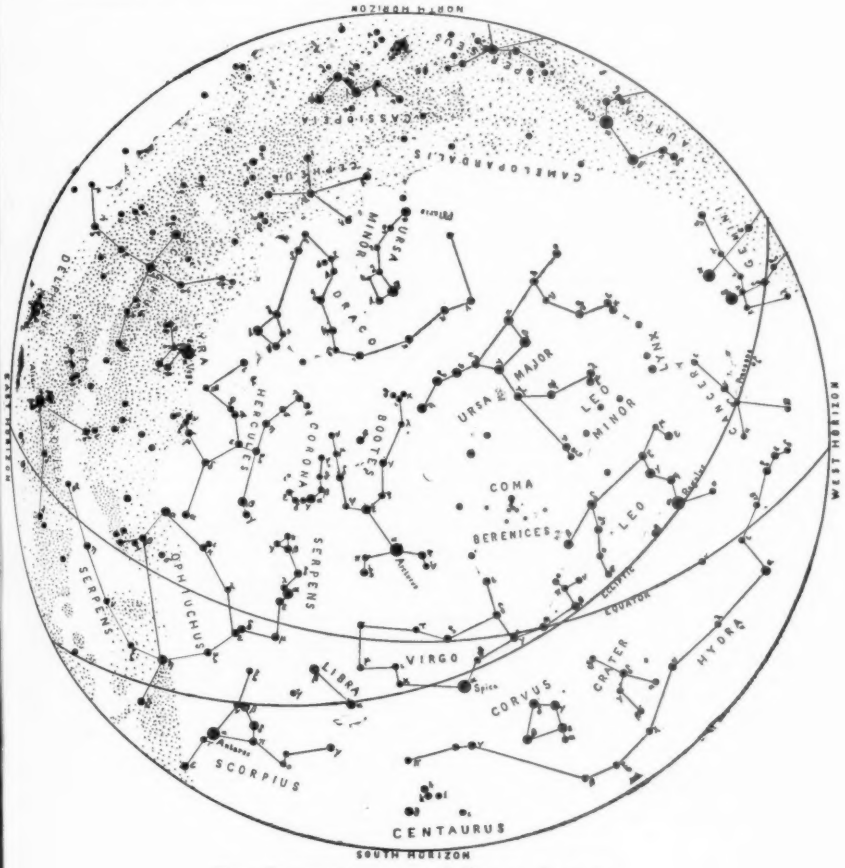
The lump-like appearance you mention is probably a low zone in the center of the mirror.

I have purchased brass tubing from a "Model Works" advertising in *Popular Mechanics.* I haven't the address at hand.

Keep on. You will get a good instrument eventually.

PLANET NOTES FOR JUNE.

The *Sun* during this month will first move north and then south, reaching its greatest declination north for the year on June 22. This is the time of the summer solstice. It will pass from the constellation Taurus into the constellation Gemini just north of the constellation Orion. This brilliant part of the sky will consequently be invisible during this month.



THE CONSTELLATIONS AT 9:00 P. M. JUNE 1.

The phases of the *Moon* will occur as follows:

Last Quarter	June	3 at	2 A.M.	C.S.T.
New Moon		10 "	4 A.M.	"
First Quarter		18 "	5 A.M.	"
Full Moon		25 "	3 P.M.	"

The moon will be nearest the earth for the month on June 1, and farthest from the earth on June 16.

Mercury will be at a point of superior conjunction on June 4. Its motion eastward, although more rapid than the sun, will not carry it far enough from the sun to be visible during this month. Towards the end of the month it will approach a position of greatest elongation east.

Venus will be a few hours west of the sun throughout this month. Its motion eastward will be at about the same rate as that of the sun. It consequently will continue as a brilliant morning star, crossing the meridian soon after 9 o'clock in the morning.

Mars will rise near midnight during June. It will be moving eastward slowly in the constellation Cetus. It will cross the equator from south to north on June 24.

Jupiter will rise about an hour and a half before midnight and therefore will also be a brilliant morning star. It will be south of the equator, moving eastward slowly in the constellation Aquarius.

Saturn will rise before sunset during June and be favorably situated for evening observation during this month. This planet is a constant source of delight to the amateur, and usually a pleasant surprise to those seeing it for the first time through the telescope. The season this year is especially favorable for viewing Saturn.

Uranus will be in quadrature with the sun (90° west) on June 21. It will therefore rise at midnight. It will be very near the equator and moving northward slowly.

Neptune will be about five hours east of the sun. It will therefore be barely observable in the evening just after dark. It will however be rather low in the west.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1926	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
June 4	30 Piscium	4.7	3 32	61	4 44	246	1 12
24	131 B. Scorpii	5.5	1 22	88	2 32	290	1 10
24	52 Ophiuchi	6.4	21 40	100	23 0	289	1 20

Saturn's Satellites.

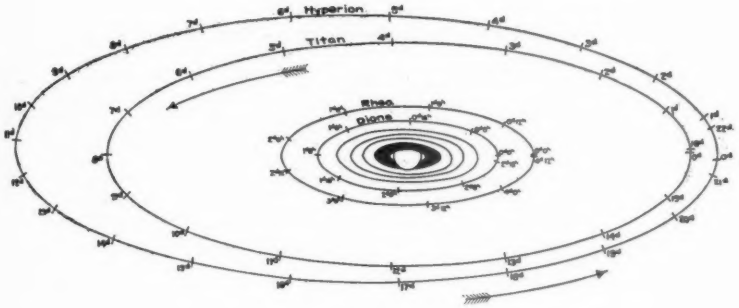
[From the *American Ephemeris.*]

CENTRAL STANDARD TIME, MIDNIGHT = 0^h

I. Mimas. Period 0^d 22^h6.

1926	d	h		d	h		d	h		d	h	
June	0	21.2 W	June	7	22.7 E	June	15	0.4 W	June	23	0.6 E	
	1	19.8 W		8	21.4 E		15	23.0 W		23	23.2 E	
	4	4.3 E		9	20.0 E		16	21.6 W		24	21.9 E	
	5	2.9 E		12	4.5 W		17	20.3 W		25	20.5 E	
	6	1.5 E		13	3.2 W		21	3.4 E		26	19.1 E	
	7	0.1 E		14	1.8 W		22	2.0 E		30	2.3 W	

South



North

Apparent orbits of the seven inner satellites of Saturn at date of opposition, May 14, 1926, as seen in an inverting telescope.

II. Enceladus. Period $1^d\ 8^h9$.

1926	d	h		d	h	1926	d	h		d	h	
June	1	12.0	E	June 9	17.3	E	June 16	13.8	E	June 23	10.2	E
	2	20.9	E	11	2.2	E	17	22.6	E	24	19.1	E
	4	5.8	E	12	11.1	E	19	7.5	E	26	3.9	E
	5	14.7	E	13	20.0	E	20	16.4	E	27	12.8	E
	6	23.6	E	15	4.9	E	22	1.3	E	28	21.7	E
	8	6.5	E							30	6.6	E

III. Tethys. Period $1^d\ 21^h3$.

June	1	16.2	E	June 9	5.4	E	June 16	18.6	E	June 24	7.8	E
	3	13.5	E	11	2.7	E	18	15.9	E	26	5.1	E
	5	10.8	E	13	0.0	E	20	13.2	E	28	2.4	E
	7	8.1	E	14	21.3	E	22	10.5	E	29	23.7	E

IV. Dione. Period $2^d\ 17^h7$.

June	1	21.5	E	June 10	2.5	E	June 18	7.4	E	June 26	12.5	E
	4	15.2	E	12	20.1	E	21	1.1	E	29	6.1	E
	7	8.8	E	15	13.8	E	23	18.8	E			

V. Rhea. Period $4^d\ 12^h5$.

June	0	21.6	E	June 9	22.3	E	June 18	23.0	E	June 27	23.6	E
	5	9.9	E	14	10.6	E	23	11.3	E			

VI. Titan. Period $15^d\ 23^h3$.

June	2	7.8	E	June 10	9.4	W	June 18	5.5	E	June 26	7.0	W

VII. Hyperion. Period $21^d\ 7^h6$.

				June 10	13.2	W	June 20	12.2	E			

VIII. Japetus. Period $79^d\ 22^h1$.

May	20	5.1	S	June 8	14.4	E	June 27	4.8	I	July 16	23.6	W

NOTE—E, Eastern Elongation; W, Western Elongation; S, Superior Conjunction; I, Inferior Conjunction.

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1926 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	6 23							
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	4 18	12 11	20 3	27 19				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	3 11	10 22	18 10	25 21				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	5 3	11 5	23 11	29 13				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	3 11	12 1	20 15	29 4				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	6 18	13 14	20 11	27 8				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	7 11	14 15	21 19	28 23				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	8 21	17 15	26 10					
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	2 10	10 9	18 7	25 6				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6		18 15						
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	6 7	14 21	23 12					
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4 2	10 21	17 16	24 11				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	2 17	10 15	18 12	26 10				
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	2 10	10 17	19 1	27 8				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	1 22	9 20	17 17	25 15				
RW Persei	13.3	+42 04	8.8—11.0	13 04.8		10 20	24 0					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	4 23	11 6	23 20	30 3				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1		13 4	25 14					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	6 3	12 19	19 13	26 3				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	7 1	15 5	23 10					
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	6 5	12 6	24 7	30 7				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	6 3	14 19	23 11					
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	3 17	14 3	24 12					
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	5 0	13 1	21 1	29 1				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	3 8	9 1	20 12	26 6				
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	6 3	11 17	22 22	28 12				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	4 16	12 21	21 2	29 7				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	5 18	13 9	21 0	28 15				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0		18 6	30 11					
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	3 11	10 15	17 19	24 23				
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	6 9	13 4	19 23	26 20				
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	7 23	17 7	26 14					
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	3 1	9 15	22 21	29 14				
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	3 15	12 1	20 11	28 20				
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	6 13	12 23	19 10	25 20				
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	5 4	12 10	19 17	26 23				
X Carinæ	8 29.1	—58 53	7.9— 8.7	0 13.0	9 1	17 3	25 6					
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	7 15	17 3	26 15					
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 06.8	6 4	13 1	19 21	26 17				
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	2 16	8 14	20 11	26 9				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	4 4	10 22	17 16	24 10				
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	8 2	15 12	22 22	30 8				
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	3 16	10 6	23 11	30 1				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	4 3	12 23	21 17	30 12				
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	7 18	15 2	22 10	29 18				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	6 10	13 18	20 13	27 8				
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	7 2	14 15	22 3	29 15				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	6 19	16 10	26 0					
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	2 21	10 7	17 17	25 4				

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of minima in 1926 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Hydræ	13 39.0	−26 23	8.6—12.7	2 21.5	4 8	10 3	21 17	27 12				
δ Libræ	14 55.6	− 8 07	4.8— 6.2	2 07.9	1 4	8 3	22 3	29 2				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	7 18	14 16	21 14	28 11				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	1 17	10 3	18 13	26 23				
SS Libræ	15 43.4	−15 14	9.3—11.5	0 18.4	6 14	13 18	20 22	28 3				
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	5 14	12 22	20 6	27 15				
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	1 3	9 9	17 15	25 21				
R Aræ	31.1	−56 48	6.8— 7.9	4 10.2	5 12	14 9	23 5					
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	3 17			24 11				
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	5 1	11 21	18 16	25 11				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	1 16.2	4 4	12 14	20 23	29 8				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	4 6	10 9	22 17	28 20				
TX Herculis	15.4	+42 00	8.3— 9.0	2 01.4	2 9	8 14	20 22	27 3				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	1 23	9 8	16 17	24 2				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	6 9	14 13	22 18	30 22				
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	2 19	10 8	17 21	25 10				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 3	9 20	17 14	25 8				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	2 22	10 22	18 21	26 21				
WX Sagittarii	53.6	−17 24	9.2—10.8	2 03.1	7 13	16 2	24 14					
WY Sagittarii	17 54.9	−23 01	9.5—10.6	4 16.0	4 4	13 12	18 5	27 13				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	2 23	13 7	18 11	28 19				
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	7 8	14 14	21 20	29 2				
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	6 13	13 11	20 9	27 7				
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2		11 20	27 0					
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	6 19	13 23	21 3	28 6				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	7 16	14 18	21 21	29 0				
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8	2 20	11 3	19 11	27 18				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	4 4	12 15	21 3	29 15				
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	5 19	12 10	19 2	25 17				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8		11 5	24 2					
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	2 0	9 16	17 7	24 22				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	3 12	11 1	18 15	26 5				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	3 17	10 22	18 3	25 7				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	5 20	14 19	23 18					
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	6 1	12 19	19 13	26 8				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	1 14	8 23	16 7	23 16				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	6 4	11 10	21 21	27 3				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	1 21	8 10	21 11	28 0				
SV Cygni	19 42.7	+32 28	10. —12	6 00.2	1 10	7 11	19 11	25 11				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	1 23	8 14	21 20	28 12				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	2 11	11 14	20 17	29 21				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	2 21	11 7	19 17	28 4				
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	4 3	10 23	17 17	24 12				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	6 11	13 9	20 7	27 4				
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0			20 22					
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	4 22	14 12	19 8	28 22				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	6 20	16 1	25 6					
Y Cygni	48.1	+34 17	7.1— 7.9	2 23.9	5 5	14 5	23 5					
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	6 15	14 6	21 20	29 10				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2		10 19	20 21					
RY Aquarii	21 14.8	−11 14	8.8—10.4	1 23.2	7 10	15 6	23 3					
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3				30 12				
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	3 1	13 4	18 6	28 9				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	5 9	10 13	20 22	26 2				
VW Pegasi	51.7	+32 42	10.0—10.6	5 06.4	2 15	13 4	18 10	28 23				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	4 5	11 18	19 6	26 19				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	2 14	10 20	19 2	27 8				

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1926 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			10 23					
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	2 23		11 2		19 5		27 9	
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	3 6		11 0		18 18		26 12	
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	3 5				18 1			
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6 2		14 1		21 23		29 22	
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	5 7		13 2		20 22		28 17	
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0			14 3		30 13			
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	8 18		17 8		25 22			
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	8 8		19 12		30 15			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	8 15		20 6		31 21			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	3 17		11 9		19 1		26 16	
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	9 13		19 16		29 20			
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	1 5		8 22		16 16		24 9	
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	5 16		11 5		22 6		27 19	
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	1 20		9 10		16 23		24 13	
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3			12 8					
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	7 19		15 7		22 17		30 4	
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	6 20		14 18		22 16		30 14	
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	4 11		14 15		24 19			
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5			13 2					
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	7 5		15 3		23 2			
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	1 5		7 22		21 7		28 1	
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	1 4		10 11		19 18		29 1	
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	6 2		14 20		23 14			
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7								
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	4 3		10 22		17 17		24 12	
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	1 15		8 6		21 11		28 1	
S Muscæ	12 07.4	—69 36	6.4— 7.3	9 15.8			10 1		19 16		29 8	
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	7 15		15 14		23 13			
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	2 8		9 2		22 13		29 6	
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	1 0		12 16		18 12		30 3	
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	2 20		12 5		16 22		26 7	
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5			10 14		27 21			
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	3 3		11 8		19 12		27 17	
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	5 4		12 5		19 5		26 6	
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	4 6		11 15		19 1		26 11	
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	6 9		11 21		22 21		28 8	
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	7 4		14 17		22 6		29 19	
R Trian.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	1 1		7 20		21 9		28 4	
S Trian.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	5 22		12 7		18 14		24 22	
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	8 4		17 22		27 16			
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	4 23		13 20		22 16			
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	4 12		10 13		22 16		28 18	
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	1 17		8 17		22 18		29 18	
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9	1 9				18 12			
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	2 6		9 20		17 10		26 0	
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	5 15		11 9		22 22		28 17	
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	1 9		8 2		21 14		28 8	
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3			11 3		21 12			
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	3 9		11 2		18 17		26 10	
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	6 12		13 22		21 9		28 19	
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	9 4		18 6		27 8			
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	1 2		8 3		15 3		22 4	

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of maxima in 1926 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	7 5	14 5	21 5	28 5				
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	3 13	11 12	19 12	27 11				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4 2	11 18	19 11	27 4				
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	6 17	13 21	21 1	28 6				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	7 3	15 12	23 21					
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	1 5	7 13	20 4	26 12				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	8 21		25 7					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	1 16	10 12	14 23	23 20				
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	6 4	13 11	20 18	28 1				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	1 19	18 23	23 7	30 11				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	7 22		22 17					
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	3 20	11 17	19 13	27 10				
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	3 5	10 3	23 21	30 18				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	2 13	12 6	17 3	26 20				
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	8 7	16 23	25 15					
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	5 17	11 2	21 19	27 4				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	5 22	16 20	27 17					
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	6 10	12 20	19 6	25 16				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	3 12	8 12	18 11	28 11				
X Lacertæ	22 45 0	+55 54	8.2— 8.6	5 10.7	5 20	11 6	22 4	29 14				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	2 13	13 10	18 21	29 18				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	1 23	8 6	20 21	24 4				
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	5 20	18 0	30 3					
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	6 18	13 18	20 17	27 17				

Monthly Report of the American Association of Variable Star Observers, March, 1926.

The names of several new observers appear in the present report. Misses Hill, Groce and Cunningham are student observers at Vassar, working under the guidance of Miss Hawes. Messrs. Koslov, Parenago, Maiseiev, Tchernov, Türk and Vorontsov-Velyaminov are members of the Observing Corporation of the Society of Amateurs of Moscow. We welcome all of these contributors to our ranks and commend them for the excellence of their reports.

Mr. D. B. Pickering, who during his European trip is visiting our fellow members whenever possible to find them, has sent us a brief account of his visit to Capodimonte, Italy, where he was so graciously received by our honorary member, Professor Azegtio Bemporad. Forthcoming issues of Variable Comments will contain extracts from these very interesting accounts of Mr. Pickering's personal experiences, which he describes in a most pleasing style.

With the approach of more clement weather, we may expect to see more voluminous reports in the near future. Observing conditions throughout the world have been unusually poor during the past few months, according to advices received from all quarters.

Our special irregular variables have all been in the limelight recently. SU Tauri, which gave every indication of a rise to maximum late in March, suddenly took a drop to minimum, below the fourteenth magnitude. SS Cygni was at maximum about March 17. SS Aurigae and U Geminorum were both at maximum brightness on March 28, the former passing through a short, narrow maximum, and the latter, a long, wide maximum. Nova Pictoris, 1925, has faded

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926.

Jan. 0 = J. D. 2424516; Feb. 0 = J. D. 2424547; March 0 = J. D. 2424575.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
000339 V SCULPTORIS—						
	4525.5	[13.3	Bl			
001032 S SCULPTORIS—						
	4516.9	8.2	Kd	4528.0	8.4	Bl
	4519.9	8.2	Kd	4540.0	8.8	Bl
	4521.0	8.2	Bl	4546.0	9.4	Bl
	4522.9	8.4	Kd			
001046 X ANDROMEDAE—						
	4560.6	14.2	Wf	4582.6	14.9	Wf
	4577.7	14.8	Wf			
001620 T CETI—						
	4535.9	5.8	Kd	4545.9	5.6	Kd
001726 T ANDROMEDAE—						
	4552.1	[11.8	Ch			
001755 T CASSIOPEIAE—						
	4541.1	7.4	Ch	4570.6	7.3	Ie
	4559.1	7.4	Ch	4575.7	6.9	Sg
	4562.2	7.2	L	4576.5	7.3	Pt
001838 R ANDROMEDAE—						
	4560.6	14.7	Wf	4580.6	14.2	Wf
	4576.6	14.7	Wf	4582.6	14.1	Wf
001862 S TUCANAE—						
	4525.0	12.6	Bl	4546.0	9.0	Bl
	4540.0	10.0	Bl			
001909 S CETI—						
	4522.0	13.0	Kd	4552.1	[11.2	Ch
002546 T PHOENICIS—						
	4521.0	11.9	Bl	4528.0	11.8	Bl
002833 W SCULPTORIS—						
	4525.0	13.1	Bl			
003179 Y CEPHEI—						
	4596.7	13.5	Cu			
004047 U CASSIOPEIAE—						
	4560.6	[15.0	Wf	4577.6	15.4	Wf
	4575.7	[12.1	Sg	4582.6	15.1	Wf
004132 RW ANDROMEDAE—						
	4551.1	8.2	Ch	4576.5	8.0	Pt
	4561.1	8.1	Ch			
004435 X SCULPTORIS—						
	4525.0	13.2	Bl			
004533 RR ANDROMEDAE—						
	4560.6	14.8	Wf	4582.6	[14.8	Wf
	4577.6	14.9	Wf			
004746a RV CASSIOPEIAE—						
	4560.6	15.3	Wf	4584.6	15.4	Wf
	4577.6	[15.3	Wf			
004746b — CASSIOPEIAE—						
	4560.6	10.6	Wf	4577.6	10.8	Wf
	4576.5	10.8	Pt	4584.6	10.8	Wf
004958 W CASSIOPEIAE—						
	4565.5	11.2	B	4578.5	11.1	B
	4576.5	10.8	Pt	4584.4	11.0	Lp
005475 U TUCANAE—						
	4521.0	12.6	Bl	4540.0	12.0	Bl
	4528.0	12.1	Bl	4546.0	11.2	Bl
005840 RX ANDROMEDAE—						
	4567.5	11.6	Pt	4584.5	10.8	Cu
	4574.5	[11.7	Pt	4584.5	11.3	Pt
	4575.5	[12.4	Pt	4588.5	13.2	Pt
005840 RX ANDROMEDAE—Continued.						
	4576.5	[11.7	Pt	4588.5	12.8	Cu
	4578.5	[12.4	Pt	4592.5	[11.7	Pt
	4579.5	13.5	Cu	4593.5	[12.8	Cu
	4580.5	[11.7	Pt	4596.5	13.4	Cu
	4581.5	13.2	Cu			
010630 U SCULPTORIS—						
	4525.0	13.5	Bl			
010940 U ANDROMEDAE—						
	4560.6	11.3	Wf	4577.6	10.3	Wf
	4570.6	10.3	Ie	4584.6	10.0	Wf
011041 UZ ANDROMEDAE—						
	4560.6	14.7	Wf	4584.6	15.2	Wf
	4577.6	15.3	Wf			
011272 S CASSIOPEIAE—						
	4560.6	14.7	Wf	4580.7	14.8	Wf
	4576.6	14.7	Wf	4584.6	15.0	Wf
011712 U PISCIUM—						
	4579.5	12.6	Pt			
012502 R PISCIUM—						
	4552.1	8.2	Ch	4579.5	7.6	Pt
	4561.1	7.8	Ch			
013238 RW ANDROMEDAE—						
	4548.1	9.9	Ch	4577.6	10.8	Wf
	4560.1	10.0	Ch	4578.5	11.0	B
	4560.6	10.6	Wf	4579.5	11.2	Pt
	4565.6	10.8	B	4584.6	11.3	Wf
013338 Y ANDROMEDAE—						
	4549.1	8.8	Ch	4565.6	9.8	B
	4560.1	9.3	Ch	4579.5	9.9	Pt
014958 X CASSIOPEIAE—						
	4565.6	10.6	B	4579.5	11.0	Pt
	4578.6	10.6	B			
015354 U PERSEI—						
	4561.2	10.3	Ch	4583.6	9.8	B
	4579.5	9.9	Pt			
021024 R ARIETIS—						
	4541.1	10.0	Ch	4577.5	13.1	B
	4548.1	10.5	Ch	4577.6	12.5	Wf
	4556.2	11.0	Ch	4578.5	12.0	Hs
	4558.6	10.9	Ci	4578.5	11.8	Ci
	4558.6	10.9	Hs	4579.5	12.1	Pt
	4558.6	10.9	Gc	4580.6	12.5	Cy
	4560.6	11.4	Wf	4584.6	13.3	Wf
	4563.5	12.0	Lv	4585.5	12.0	Hs
	4563.6	11.2	Hs			
021143a W ANDROMEDAE—						
	4541.1	6.8	Ch	4570.6	8.4	Ie
	4547.0	7.2	Ch	4577.6	8.6	Wf
	4552.1	7.4	Ch	4579.5	8.3	Pt
	4560.6	7.9	Wf	4584.6	9.1	Wf
021258 T PERSEI—						
	4543.2	8.7	Ch	4579.5	8.4	Pt
	4561.2	8.7	Ch			
021281 Z CEPHEI—						
	4577.6	11.0	Wf	4584.6	11.0	Wf
	4578.6	11.1	B	4596.8	10.6	Cu
	4579.5	10.4	Pt			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
021403 o CETI—						
	4441.9	6.5	Tc	4536.0	5.1	Kd
	4460.8	4.9	Tc	4536.2	4.4	Ch
	4465.8	4.8	Tc	4540.2	4.4	Ch
	4468.7	4.8	Tc	4545.9	5.8	Kd
	4469.7	4.0	Tc	4548.0	5.8	Kd
	4470.8	4.1	Tc	4552.0	5.2	Ch
	4476.8	2.6	Tc	4552.6	5.7	Al
	4490.8	2.6	Tc	4557.0	6.1	Kd
	4500.8	3.4	Tc	4557.1	5.3	Ch
	4514.9	3.9	Kd	4558.9	6.3	Kd
	4516.9	3.9	Kd	4560.6	5.7	Wf
	4519.0	3.8	Kd	4561.1	5.4	Ch
	4519.9	4.0	Kd	4561.2	5.3	L
	4522.0	3.9	Kd	4566.5	5.9	Cy
	4522.9	4.0	Kd	4572.5	6.0	Cy
	4524.9	4.0	Kd	4575.5	6.2	Cy
	4525.9	4.1	Kd	4577.6	6.4	Wf
	4528.9	4.3	Kd	4578.5	6.7	Cy
	4532.8	3.7	Tc	4584.6	6.6	Cy
	4533.6	4.0	Sm	4584.6	6.6	Wf
	4534.0	4.9	Kd			
021558 S PERSEI—						
	4553.2	9.7	Ch	4583.6	10.0	B
	4561.2	9.8	Ch	4584.4	9.9	Lp
	4579.5	9.5	Pt			
022000 R CETI—						
	4552.1	8.5	Ch	4561.1	8.6	Ch
022150 RR PERSEI—						
	4577.6	13.1	B	4584.6	13.0	Wf
	4577.6	12.9	Wf	4591.6	12.9	B
	4579.5	13.0	Pt			
022426 R FORNACIS—						
	4521.0	9.6	Bl	4540.0	9.5	Bl
	4528.0	9.6	Bl	4546.0	9.8	Bl
022813 U CETI—						
	4548.1	8.3	Ch	4559.1	8.5	Ch
	4552.1	8.4	Ch	4579.5	8.3	Pt
022980 RR CEPHEI—						
	4577.6	14.5	Wf	4596.8	[13.6	Cu
	4584.6	14.5	Wf			
023133 R TRIANGULI—						
	4324.9	8.3	Vv	4410.8	6.6	Pg
	4326.0	8.3	Vv	4413.7	6.4	Ko
	4327.0	8.3	Vv	4413.9	6.8	Tu
	4328.0	8.5	Vv	4415.7	6.8	Pg
	4329.0	8.7	Vv	4415.8	6.4	Tu
	4330.0	8.2	Vv	4416.8	6.8	Pg
	4332.0	8.2	Vv	4417.7	6.9	Ko
	4333.0	8.6	Vv	4418.0	6.6	Vv
	4335.0	8.5	Vv	4418.8	6.8	Pg
	4354.0	8.4	Vv	4418.9	6.5	Ko
	4355.0	7.8	Vv	4420.0	6.6	Tu
	4359.0	8.0	Vv	4420.8	6.9	Pg
	4360.0	8.0	Vv	4430.9	7.1	Tu
	4361.0	7.9	Vv	4434.7	7.6	Vv
	4362.0	7.9	Vv	4434.7	7.6	Ko
	4363.9	7.8	Pg	4434.8	7.1	Tu
	4363.9	8.5	Ko	4435.9	7.9	Vv
	4364.0	7.9	Vv	4435.9	7.6	Tu
	4375.0	7.7	Pg	4436.7	7.7	Vv
023133 R TRIANGULI—Continued.						
	4375.9	7.4	Ko	4436.9	7.6	Tu
	4377.0	7.7	Vv	4440.9	7.7	Vv
	4377.9	7.6	Vv	4441.0	8.1	Tu
	4377.9	7.3	Pg	4441.8	7.6	Pg
	4377.9	6.6	Ko	4444.7	8.0	Vv
	4378.9	6.6	Vv	4444.8	8.1	Tu
	4380.9	7.4	Pg	4446.6	8.1	Vv
	4380.9	6.6	Ko	4446.8	8.1	Ko
	4389.7	6.2	Vv	4461.7	8.2	Pg
	4389.8	6.2	Pg	4468.9	8.8	Vv
	4389.8	6.2	Ko	4561.2	11.3	Ch
	4392.0	6.3	Vv	4563.6	10.5	Lv
	4397.8	6.1	Ko	4570.5	10.4	Ie
	4400.8	6.4	Pg	4570.6	10.2	Hs
	4401.8	6.3	Pg	4570.6	10.1	Ci
	4405.8	6.1	Vv	4578.6	10.0	Hs
	4405.8	6.1	Ko	4578.6	10.0	Ci
	4406.9	6.2	Vv	4579.5	10.2	Pt
	4408.8	6.6	Pg	4580.6	9.6	Cy
	4409.8	6.6	Pg	4584.5	9.5	Bi
	4409.8	6.2	Ko	4585.6	9.7	Hs
	4409.9	6.0	Vv	4585.6	9.8	Ci
	4409.9	6.2	Tu			
024356 W PERSEI—						
	4561.2	9.5	Ch	4579.5	9.4	Cy
	4572.6	9.4	Cy	4579.5	8.9	Pt
	4575.6	9.5	Cy	4583.6	9.1	B
025050 R HOROLOGII—						
	4521.0	7.4	Bl	4540.0	7.7	Bl
	4528.0	7.6	Bl	4546.0	8.4	Bl
025751 T HOROLOGII—						
	4521.0	10.6	Bl	4540.0	9.5	Bl
	4528.0	9.8	Bl	4546.0	8.1	Bl
030514 U ARIETIS—						
	4553.2	[12.2	Ch	4577.5	14.5	B
031401 X CETI—						
	4560.6	9.6	Wf	4579.5	10.6	Pt
	4562.2	9.7	L	4584.6	11.0	Wf
	4577.6	10.7	Wf			
032043 Y PERSEI—						
	4553.2	8.6	Ch	4579.5	8.4	Pt
032335 R PERSEI—						
	4558.6	9.0	Hs	4578.5	9.0	Hs
	4558.6	9.2	Ci	4578.5	9.0	Ci
	4558.6	9.2	Gc	4579.5	9.1	Pt
	4563.6	8.8	Hs	4580.5	8.9	Ci
	4563.6	8.9	Ci	4580.5	8.9	Gc
	4567.6	9.3	B	4584.4	8.8	Lp
	4570.6	9.2	Ie	4584.6	9.4	Wf
	4570.6	9.0	Hs	4586.5	9.1	Ci
	4570.6	8.9	Ci	4586.5	9.2	Gc
	4577.7	9.1	Wf			
041619 T TAURI—						
	4579.6	10.2	Cu	4596.6	10.4	Cu
	4593.5	10.4	Cu			
042209 R TAURI—						
	4553.2	9.4	Ch	4579.5	9.0	Pt
	4561.2	9.3	Ch	4591.6	9.4	B
	4577.6	8.8	B			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
042215 W TAURI—						
	4570.6	10.0	Hs	4578.6	9.9	Ci
	4570.6	10.1	Ci	4579.5	9.5	Pt
	4572.6	9.6	Cy	4580.5	10.1	Ci
	4575.7	9.9	Sg	4580.5	10.1	Gc
	4576.6	9.6	B	4586.5	10.2	Ci
	4578.6	10.0	Cy	4586.5	10.3	Gc
	4578.6	9.7	Hs	4591.6	10.1	B
042309 S TAURI—						
	4553.2	[10.6	Ch	4591.6	[13.0	B
043065 T CAMELOPARDALIS—						
	4562.3	14.0	L	4579.5	13.6	Pt
043208 RX TAURI—						
	4562.5	10.1	Bi	4584.6	10.4	Bi
	4577.7	10.4	B	4591.6	11.2	B
	4579.5	10.7	Pt			
043263 R RETICULI—						
	4521.0	11.8	Bl	4528.0	12.4	Bl
043274 X CAMELOPARDALIS—						
	4559.1	8.8	Ch	4579.7	10.8	Gb
	4567.7	9.2	B	4591.6	11.7	B
	4579.5	10.9	Pt			
043562 R DORADUS—						
	4521.0	5.5	Bl	4540.0	5.5	Bl
	4528.0	5.4	Bl	4546.0	5.4	Bl
043738 R CAELI—						
	4525.0	[12.5	Bl			
044349 R PICTORIS—						
	4521.0	8.6	Bl	4540.0	8.5	Bl
	4528.0	8.2	Bl	4546.0	8.6	Bl
044617 V TAURI—						
	4560.2	9.5	Ch	4584.4	9.4	Lp
	4577.6	9.3	B	4584.6	9.4	Wf
	4577.7	9.2	Wf	4588.5	9.3	Ie
	4579.5	9.4	Pt	4591.6	9.4	B
045307 R ORIONIS—						
	4578.6	12.3	B	4585.6	12.6	Ie
045514 R LEPORIS—						
	4539.0	9.2	Ch	4578.6	8.9	Mh
	4550.0	9.3	Ch	4579.5	7.7	Pt
	4560.0	9.1	Ch	4583.6	8.2	B
	4562.2	8.0	L			
050003 V ORIONIS—						
	4553.2	[10.8	Ch	4579.5	13.5	Pt
	4578.6	[13.0	B			
050022 T LEPORIS—						
	4521.0	8.1	Bl	4546.0	8.2	Bl
	4528.0	7.8	Bl	4579.5	9.0	Pt
	4540.0	8.2	Bl			
050848 S PICTORIS—						
	4521.0	13.5	Bl	4528.0	13.5	Bl
050953 R AURIGAE—						
	4563.6	13.5	Lv	4585.6	13.8	Bi
	4576.6	13.5	Wf	4585.6	13.5	Ie
	4579.5	13.7	Pt	4586.6	[12.0	Ci
	4584.6	13.5	Wf	4586.6	[12.0	Gc
051247 T PICTORIS—						
	4525.0	[13.1	Bl			
051533 T COLUMBAE—						
	4521.0	8.5	Bl	4540.0	8.1	Bl
	4528.0	8.4	Bl	4546.0	7.3	Bl
052034 S AURIGAE—						
	4555.2	8.8	Ch	4585.6	9.0	Ci
	4579.5	8.3	Pt	4586.6	9.1	B
	4585.6	9.0	Hs			
052036 W AURIGAE—						
	4555.2	10.2	Ch	4585.6	11.1	Ie
	4577.6	10.7	B	4591.6	11.0	B
	4579.5	11.0	Pt			
052404 S ORIONIS—						
	4576.6	9.2	B	4585.6	9.7	Hs
	4579.5	9.7	Hs	4585.6	9.7	Ci
	4579.6	9.7	Ci	4591.6	9.4	B
053005a T ORIONIS—						
	4561.2	10.0	L	4579.5	10.5	Pt
	4562.3	10.3	L	4579.6	10.2	Cu
	4565.3	10.2	L	4580.5	10.5	Pt
	4566.3	10.2	L	4580.6	10.7	Ie
	4566.5	10.5	Pt	4584.5	10.3	Pt
	4567.5	10.3	Pt	4586.5	10.4	Pt
	4567.7	11.0	B	4588.5	10.5	Pt
	4570.5	10.5	Pt	4589.5	10.6	Ie
	4570.6	10.2	Ie	4591.6	10.2	B
	4574.5	10.5	Pt	4592.5	10.4	Pt
	4575.5	10.5	Pt	4593.5	10.3	Pt
	4576.5	10.5	Pt	4593.6	9.9	Cu
	4578.5	10.6	Pt	4596.6	10.2	Cu
053068 S CAMELOPARDALIS—						
	4579.6	9.0	Pt			
053326 RR TAURI—						
	4581.7	13.0	B			
053337 RU AURIGAE—						
	4579.6	[12.4	Pt	4583.8	[12.0	Sg
053531 Y AURIGAE—						
	4555.2	[11.2	Ch	4579.6	13.0	Pt
	4583.6	12.8	B	4588.6	13.3	Ie
053920 Y TAURI—						
	4580.3	7.9	Kl			
054319 SU TAURI—						
	4521.0	12.4	Bl	4581.5	13.1	Cu
	4528.0	12.0	Bl	4581.6	13.3	B
	4540.0	11.3	Bl	4582.6	14.0	Wf
	4546.0	11.0	Bl	4583.6	13.3	B
	4552.2	[12.1	Ch	4584.6	13.9	Wf
	4560.6	[15.0	Wf	4584.6	13.1	Cu
	4562.4	[13.5	L	4584.6	13.7	Bi
	4566.5	[12.1	Pt	4585.6	13.7	Bi
	4574.5	[12.1	Pt	4585.7	13.1	Cu
	4575.5	[12.1	Pt	4588.5	13.5	Ie
	4576.6	14.1	Wf	4588.5	13.0	Cu
	4577.6	14.0	Wf	4588.6	13.3	B
	4577.6	13.7	B	4590.6	12.9	B
	4579.5	13.2	Cu	4593.5	[12.1	Pt
	4579.7	14.0	Wf	4593.5	12.6	Cu
	4580.7	14.0	Wf	4596.5	12.7	Cu
	4580.7	13.1	Cu			
054331 S COLUMBAE—						
	4521.0	12.4	Bl	4540.0	11.3	Bl
	4528.0	12.0	Bl	4546.0	11.0	Bl
054615a Z TAURI—						
	4580.6	12.8	Ie			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
054615c RU TAURI—						
	4580.6	13.8	Ie			
054629 R COLUMBAE—						
	4525.1	[13.0	Bl			
054920a U ORIONIS—						
	4535.5	10.7	Lp	4579.6	11.3	Ci
	4555.2	11.0	Ch	4579.6	11.8	Pt
	4565.6	11.7	Lv	4584.4	11.6	Lp
	4572.6	11.8	Cy	4584.6	11.7	Bi
	4578.6	12.0	Cy	4586.6	11.5	Ci
	4578.6	11.7	B	4586.6	11.5	Gc
	4579.6	11.5	Hs			
054920b UW ORIONIS—						
	4565.6	10.5	Lv	4578.6	10.5	Cy
	4572.6	10.5	Cy	4584.6	10.2	Bi
054974 V CAMELOPARDALIS—						
	4576.6	10.9	Wf	4584.6	11.2	Wf
	4577.6	11.1	B	4588.8	11.5	Cu
	4579.6	11.3	Pt	4590.6	11.2	B
	4584.5	11.1	Ie			
055353 Z AURIGAE—						
	4555.3	10.6	Ch	4578.6	9.8	Hs
	4562.2	10.6	Ch	4578.6	10.0	Ci
	4566.5	9.5	Pt	4579.6	9.6	Pt
	4567.5	9.6	Pt	4580.5	9.5	Pt
	4570.5	9.6	Pt	4581.6	9.7	B
	4570.6	9.8	Hs	4584.5	9.6	Pt
	4570.6	9.5	Ci	4584.6	10.0	Wf
	4570.6	9.6	Hi	4585.6	9.9	Hs
	4574.5	9.5	Pt	4585.6	9.8	Ci
	4575.5	9.5	Pt	4586.5	9.6	Pt
	4576.6	9.9	Wf	4588.5	9.7	Pt
	4577.6	9.6	B	4588.6	9.6	B
	4578.5	9.4	Pt	4592.5	9.9	Pt
055686 R OCTANTIS—						
	4521.0	10.0	Bl	4540.0	7.7	Bl
	4528.0	9.3	Bl	4546.0	7.5	Bl
060450 X AURIGAE—						
	4537.0	10.3	Ch	4574.6	9.0	Ie
	4550.0	10.1	Ch	4577.6	8.6	B
	4553.2	9.1	Ch	4579.6	8.4	Pt
	4560.0	8.8	Ch	4586.6	8.7	Ci
	4562.2	8.9	Ch	4586.6	8.7	Gc
060547 SS AURIGAE—						
	4536.4	[11.6	Ch	4676.6	15.1	Wf
	4537.0	[11.2	Ch	4577.7	15.4	Wf
	4548.1	[11.6	Ch	4578.6	[13.0	Cy
	4550.0	[11.6	Ch	4579.6	15.0	Cu
	4552.0	[11.6	Ch	4579.7	15.1	Wf
	4553.2	[11.6	Ch	4580.7	15.0	Wf
	4555.2	10.9	Ch	4581.7	[14.5	Cu
	4556.2	10.9	Ch	4582.6	15.1	Wf
	4557.2	11.7	Ch	4583.6	[13.8	B
	4559.2	[11.6	Ch	4584.6	15.0	Cu
	4560.6	15.0	Wf	4584.7	15.0	Wf
	4561.1	[11.6	Ch	4585.7	14.8	Cu
	4562.3	[14.5	L	4586.6	[14.5	Wf
	4563.2	[11.6	Ch	4588.6	15.1	Cu
	4565.6	[14.0	L	4589.5	[13.3	Ie
	4566.8	[13.3	Wf	4590.6	[14.0	B
	4567.5	[12.4	Pt	4591.6	[14.0	B
060547 SS AURIGAE—Continued.						
	4570.6	[12.6	Ie	4592.5	[12.6	Pt
	4572.6	[12.4	Cy	4593.5	[14.5	Cu
	4574.5	[12.6	Ie	4596.5	[14.5	Cu
	4575.5	[14.5	Wf	4599.7	[13.9	Cu
061647 V AURIGAE—						
	4588.6	11.6	B			
061702 V MONOCEROTIS—						
	4557.2	7.9	Ch	4579.6	8.5	Pt
063159 U LYNCIS—						
	4583.6	13.7	B			
063308 R MONOCEROTIS—						
	4579.6	10.7	Pt			
063462 NOVA PICTORIS—						
	4521.1	4.7	Bl	4540.0	5.4	Bl
	4525.0	4.9	Bl	4546.0	5.5	Bl
	4528.0	5.1	Bl			
063558 S LYNCIS—						
	4579.6	13.7	Pt	4596.7	14.3	Cu
	4583.7	13.8	B			
064030 X GEMINORUM—						
	4577.7	10.9	B	4588.6	12.1	Ie
064707 W MONOCEROTIS—						
	4579.6	9.0	Pt	4588.7	9.2	B
065111 Y MONOCEROTIS—						
	4557.3	[11.7	Ch	4588.2	13.3	Ch
	4579.6	13.1	Pt	4588.7	13.3	B
065208 X MONOCEROTIS—						
	4557.3	7.4	Ch	4562.2	7.2	L
065355 R LYNCIS—						
	4575.6	13.6	Wf	4584.7	13.1	Wf
	4580.7	13.4	Wf	4596.7	12.8	Cu
070109 V CANIS MINORIS—						
	4537.3	[11.7	Ch	4588.6	[13.0	Ie
	4581.6	[14.0	B			
070122a R GEMINORUM—						
	4540.0	7.7	Ch	4579.6	9.6	Ci
	4552.6	7.7	Al	4579.6	9.7	Gc
	4553.0	8.2	Ch	4580.7	9.6	Wf
	4561.0	8.7	Ch	4584.6	9.9	Lv
	4574.6	9.4	Ie	4584.7	9.6	Wf
	4575.6	9.0	Wf	4585.6	9.6	Hs
	4579.6	9.3	Pt	4585.6	9.6	Ci
	4579.6	9.7	Hs	4588.5	9.6	Al
070122b Z GEMINORUM—						
	4579.6	12.3	Pt	4584.7	12.4	Lv
070122c TW GEMINORUM—						
	4579.6	7.9	Pt	4584.6	8.3	Lv
070310 R CANIS MINORIS—						
	4562.3	9.0	L			
071201 RR MONOCEROTIS—						
	4557.3	11.1	Ch	4584.6	11.6	Lv
	4565.6	11.4	Lv			
071713 V GEMINORUM—						
	4535.5	8.9	Ie	4579.6	9.6	Pt
	4567.6	9.1	B			
072708 S CANIS MINORIS—						
	4537.0	7.9	Ch	4563.3	6.9	Ch
	4541.1	7.6	Ch	4567.6	7.1	B
	4549.1	7.2	Ch	4577.6	7.5	Ie
	4552.6	7.0	Al	4579.6	7.1	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
072708 S CANIS MINORIS—Continued.						
	4557.1	6.8	Ch	4588.5	7.7	Al
	4561.0	6.8	Ch	4588.6	7.7	Jo
	4562.3	7.0	L			
072811 T CANIS MINORIS—						
	4588.1	14.0	B			
073172 S VOLANTIS—						
	4521.0	11.2	Bl	4540.0	9.7	Bl
	4528.0	10.8	Bl	4546.0	9.3	Bl
073508 U CANIS MINORIS—						
	4562.3	9.3	L	4579.6	9.1	Pt
	4567.6	9.3	B			
073723 S GEMINORUM—						
	4536.2	9.4	Ch	4567.6	10.2	B
	4545.2	9.5	Ch	4577.6	11.1	Ie
	4549.1	9.7	Ch	4579.6	11.1	Pt
	4558.1	9.8	Ch	4588.7	11.7	B
074241 W PUPPIS—						
	4521.0	9.9	Bl	4540.0	12.2	Bl
	4528.0	10.6	Bl			
074323 T GEMINORUM—						
	4536.2	9.0	Ch	4558.1	8.9	Ch
	4539.4	8.8	Ch	4562.1	9.0	Ch
	4545.2	8.5	Ch	4579.6	8.8	Pt
	4549.1	8.7	Ch	4589.6	9.2	Ie
	4552.0	8.6	Ch			
074922 U GEMINORUM—						
	4536.4	[12.4	Ch	4579.5	[13.3	Cy
	4537.0	[10.4	Ch	4579.7	14.5	Wf
	4539.4	[12.3	Ch	4580.7	14.0	Cu
	4541.5	[11.7	Ch	4580.7	14.3	Wf
	4545.2	[9.5	Ch	4581.5	14.0	B
	4548.1	[12.4	Ch	4581.6	14.3	Wf
	4549.1	[12.4	Ch	4581.7	13.8	Cu
	4550.0	[12.3	Ch	4582.6	14.2	Wf
	4552.0	[12.4	Ch	4583.7	13.9	B
	4553.0	[11.4	Ch	4583.6	14.3	Wf
	4555.3	[12.3	Ch	4584.6	14.0	Cu
	4556.0	[11.4	Ch	4584.7	14.1	Lv
	4557.1	[12.4	Ch	4584.7	14.0	Wf
	4558.1	[12.4	Ch	4585.6	14.0	Lv
	4559.2	[12.4	Ch	4585.7	14.0	Cu
	4560.6	14.3	Wf	4586.6	14.0	Wf
	4561.1	[12.4	Ch	4588.6	14.0	Cu
	4562.3	[14.0	L	4588.6	14.0	B
	4565.6	[13.7	L	4589.6	[13.7	Ie
	4566.8	[13.3	Wf	4590.6	14.0	B
	4567.5	[12.4	Pt	4591.6	14.0	B
	4572.6	[12.4	Cy	4592.7	[13.7	Cu
	4575.6	14.1	Wf	4593.6	14.0	Cu
	4576.6	14.4	Wf	4596.5	13.9	Cu
	4577.7	14.2	Wf	4599.7	[13.3	Cu
	4578.5	[13.7	Cy			
075612 U PUPPIS—						
	4549.1	11.6	Ch	4596.6	12.1	Cu
	4581.5	11.9	B			
081112 R CANCRI—						
	4548.1	9.5	Ch	4563.2	8.0	Ch
	4557.2	8.7	Ch	4567.6	8.2	B
	4562.3	8.4	L	4579.6	7.1	Pt
081617 V CANCRI—						
	4549.1	[11.4	Ch	4579.6	13.0	Pt
	4563.2	[11.3	Ch	4591.7	13.0	B
	4576.5	12.8	B			
082405 RT HYDRAE—						
	4579.6	7.9	Pt			
082476 R CHAMAELEONTIS—						
	4525.0	[12.6	Bl			
083019 U CANCRI—						
	4576.6	14.0	Wf	4584.7	14.3	Wf
	4584.6	[13.7	Lv			
083350 X URSAE MAJORIS—						
	4565.6	11.1	B	4590.5	12.5	B
	4579.6	12.0	Pt			
084803 S HYDRAE—						
	4549.1	[11.0	Ch	4590.6	13.3	B
	4579.6	12.6	Pt			
085008 T HYDRAE—						
	4549.1	9.9	Ch	4567.6	9.8	B
	4562.4	9.8	L	4579.6	9.5	Pt
	4563.2	9.8	Ch			
085120 T CANCRI—						
	4549.1	9.4	Ch	4579.6	8.0	Pt
	4567.6	8.8	B			
090024 S PYXIDIS—						
	4579.6	9.0	Pt			
090425 W CANCRI—						
	4575.6	8.6	Wf	4584.7	7.8	Wf
	4580.7	7.9	Wf	4590.6	7.7	B
	4584.4	7.8	Lp			
091868 RW CARINAE—						
	4521.1	10.6	Bl	4540.0	9.8	Bl
	4528.0	10.1	Bl	4546.0	9.5	Bl
092551 Y VULPECULAE—						
	4521.1	12.4	Bl			
092962 R CARINAE—						
	4521.1	8.5	Bl	4540.0	9.0	Bl
	4528.0	8.7	Bl	4546.0	9.1	Bl
093014 X HYDRAE—						
	4549.1	8.4	Ch	4579.6	9.4	Pt
	4562.2	8.7	Ch			
093178 Y DRACONIS—						
	4578.6	11.3	Cy	4590.6	10.4	B
093934 R LEONIS MINORIS—						
	4535.2	10.2	Ch	4552.6	10.0	Al
	4541.1	10.1	Ch	4560.2	9.5	Ch
	4548.1	9.8	Ch	4579.6	8.9	Pt
094211 R LEONIS—						
	4538.2	6.4	Ch	4575.5	5.4	Cy
	4548.1	5.7	Ch	4579.6	5.7	Pt
	4552.6	5.8	Al	4583.8	5.3	Sg
	4555.4	5.6	Ch	4588.5	5.8	Al
	4559.1	5.4	Ch	4588.6	6.0	Jo
	4562.1	5.4	Ch	4588.6	6.0	Pw
	4565.6	5.3	B	4596.7	5.9	Jo
094512 X LEONIS—						
	4580.7	13.1	Cu	4588.7	12.8	Cu
	4581.7	13.1	Cu	4592.7	13.1	Cu
	4584.7	13.1	Cu	4593.6	13.1	Cu
	4585.7	13.0	Cu	4596.6	13.1	Cu

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
094622 Y HYDRAE—						
	4579.6	6.4	Pt			
094957 Z VELORUM—						
	4521.1	12.6	Bl	4540.0	12.3	Bl
	4528.0	12.5	Bl			
095421 V LEONIS—						
	4575.6	13.6	Wf	4581.6	13.2	B
	4579.6	13.4	Pt	4584.7	13.3	Lv
	4580.6	13.6	Cy	4584.7	13.4	Wf
	4580.7	13.3	Wf			
095563 RV CARINAE—						
	4525.0	[13.1	Bl			
095814 RY LEONIS—						
	4564.3	8.9	Kl	4580.3	8.8	Kl
100661 S CARINAE—						
	4521.1	7.5	Bl	4540.0	8.1	Bl
	4528.0	7.7	Bl	4546.0	7.6	Bl
101058 Z CARINAE—						
	4521.1	[12.6	Bl			
101153 W VELORUM—						
	4521.1	9.4	Bl	4540.0	9.7	Bl
	4528.0	9.6	Bl	4546.0	10 6	Bl
103212 U HYDRAE—						
	4527.3	5.8	Kd	4557.3	5.4	Kd
	4539.4	5.5	Kd	4564.6	4.6	L
103769 R URSAE MAJORIS—						
	4539.5	10.9	Ch	4576.6	11.9	Wf
	4552.6	11.0	Al	4579.6	12.2	Pt
	4560.2	11.3	Ch	4581.6	12.1	B
	4567.6	11.5	B	4584.7	11.9	Wf
	4575.6	11.8	Cy	4589.6	12.2	Ie
104620 V HYDRAE—						
	4521.1	11.4	Bl	4546.0	9.8	Bl
	4528.0	10.4	Bl	4552.2	11.0	Ch
	4536.4	10.7	Ch	4555.2	11.3	Ch
	4539.4	10.8	Ch	4561.3	11.2	Ch
	4540.0	9.9	Bl	4579.6	9.0	Pt
104628 RS HYDRAE—						
	4521.1	[13.0	Bl			
104814 W LEONIS—						
	4579.6	13.7	Pt	4581.6	13.5	B
	4580.6	13.0	Cy			
110506 S LEONIS—						
	4553.3	[11.8	Ch	4585.7	11.6	Cu
	4579.7	11.6	Cu	4588.7	11.3	Cu
	4580.7	11.7	Cu	4593.7	11.5	Cu
	4581.8	11.7	Cu	4596.6	11.1	Cu
111561 RY CARINAE—						
	4521.1	12.7	Bl	4528.0	12.8	Bl
	4525.0	12.7	Bl			
111661 RS CENTAURI—						
	4521.1	9.2	Bl	4540.0	9.1	Bl
	4528.0	9.0	Bl	4546.0	9.1	Bl
114441 X CENTAURI—						
	4525.0	[13.1	Bl			
115058 W CENTAURI—						
	4525.0	12.0	Bl			
115919 R COMAE—						
	4553.3	[10.9	Ch	4584.7	13.5	Wf
	4567.7	[12.7	B	4591.7	12.9	B
	4576.6	14.1	Wf			
120012 SU VIRGINIS—						
	4553.3	10.0	Ch	4579.6	9.3	Pt
	4563.3	9.0	Ch	4588.6	10.7	Pw
120905 T VIRGINIS—						
	4579.6	12.4	Pt	4583.7	12.3	B
121418 R CORVI—						
	4579.6	13.1	Pt	4591.7	12.2	B
122001 SS VIRGINIS—						
	4564.6	8.0	L			
122532 T CANUM VENATICORUM—						
	4553.3	10.4	Ch	4584.4	12.2	Lp
	4579.6	11.8	Pt	4588.7	12.2	Pw
122803 Y VIRGINIS—						
	4565.6	12.4	L	4583.7	11.0	B
122854 U CENTAURI—						
	4525.0	8.2	Bl	4540.0	7.9	Bl
	4528.0	8.0	Bl	4546.0	8.2	Bl
123160 T URSAE MAJORIS—						
	4323.8	7.7	Ko	4359.	7.9	Vv
	4326.8	7.9	Ko	4360.	7.8	Vv
	4326.	8.5	Vv	4361.	7.9	Vv
	4327.	8.4	Vv	4362.	7.9	Vv
	4328.	8.4	Vv	4363.	7.9	Vv
	4334.	7.9	Vv	4375.	8.2	Vv
	4335.	7.8	Vv	4376.	8.2	Vv
	4338.	7.8	Vv	4377.	8.3	Vv
	4340.	7.6	Vv	4378.8	8.4	Vv
	4341.	7.7	Vv	4389.8	9.0	Vv
	4342.	7.7	Vv	4552.2	10.7	Ch
	4343.	7.7	Vv	4563.2	9.4	Ch
	4344.	7.6	Vv	4567.6	9.2	B
	4345.	7.6	Vv	4564.3	8.8	Kl
	4546.	7.8	Vv	4575.7	8.4	Sg
	4347.	7.7	Vv	4576.6	8.6	Wf
	4349.	7.8	Vv	4578.6	8.8	Cy
	4350.	7.6	Vv	4579.6	8.6	Pt
	4351.	7.6	Vv	4580.3	8.8	Kl
	4352.	7.8	Vv	4584.7	8.5	Wf
	4353.	7.8	Vv	4585.3	8.8	Lp
	4354.	7.6	Vv	4589.6	8.7	Al
	4356.	7.9	Vv	4596.6	8.5	Jo
	4357.	7.7	Vv	4596.8	8.7	Cu
	4358.	7.8	Vv			
123307 R VIRGINIS—						
	4555.2	7.6	Ch	4579.6	10.6	Pt
	4564.7	8.7	L	4588.7	10.5	Pw
123459 RS URSAE MAJORIS—						
	4539.4	10.0	Ch	4578.6	12.7	Cy
	4556.2	11.0	Ch	4579.6	12.6	Pt
	4563.2	11.5	Ch	4584.7	13.2	Wf
	4567.6	11.9	B	4590.7	13.2	B
	4576.6	12.7	Wf	4596.8	13.5	Cu
123961 S URSAE MAJORIS—						
	4539.5	9.0	Ch	4579.6	10.5	Pt
	4542.2	9.3	Kl	4580.3	11.0	Kl
	4552.6	9.2	Al	4581.6	10.8	B
	4562.3	10.0	L	4584.7	11.0	Wf
	4563.2	10.1	Ch	4585.4	11.3	Lp
	4564.3	10.6	Kl	4586.8	11.1	Sg
	4567.6	10.3	B	4589.6	10.4	Al
	4576.6	10.5	Wf	4590.7	11.3	B

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
124204 RU VIRGINIS—						
	4579.6	12.4	Pt			
124606 U VIRGINIS—						
	4579.6	11.5	Pt	4591.6	13.1	B
130212 RV VIRGINIS—						
	4579.7	13.1	Wf	4583.9	12.5	Wf
131283 U OCTANTIS—						
	4525.0	11.7	Bl	4546.0	10.2	Bl
	4540.0	10.8	Bl			
132422 R HYDRAE—						
	4539.4	9.1	Ch	4564.7	8.1	L
	4557.3	9.0	Ch	4579.6	7.5	Pt
132706 S VIRGINIS—						
	4539.4	11.0	Ch	4579.7	9.8	Wf
	4557.2	9.9	Ch	4583.9	9.2	Wf
	4579.6	10.0	Pt			
133155 RV CENTAURI—						
	4525.1	7.5	Bl	4540.0	8.0	Bl
	4528.0	7.6	Bl	4546.0	7.5	Bl
133273 T URSAE MINORIS—						
	4576.6	10.9	Wf	4584.7	11.1	Wf
133633 T CENTAURI—						
	4527.3	6.4	Kd	4537.4	6.6	Kd
	4536.4	6.6	Kd	4539.4	6.8	Kd
134440 R CANUM VENATICORUM—						
	4579.6	10.4	Pt	4585.4	10.4	Lp
134677 T APODIS—						
	4525.0	[13.2	Bl			
140113 Z BOOTIS—						
	4576.7	12.2	Wf	4583.9	12.8	Wf
140959 R CENTAURI—						
	4525.0	11.2	Bl	4540.0	10.5	Bl
141567 U URSAE MINORIS—						
	4536.4	8.4	Ch	4588.7	10.5	Pw
	4557.2	8.5	Ch	4591.6	9.3	Gb
	4579.6	9.7	Pt	4596.6	8.7	Jo
141954 S BOOTIS—						
	4536.4	[11.7	Ch	4579.6	10.9	Pt
	4555.3	[11.6	Ch	4583.8	11.0	Sg
	4565.3	11.6	L	4583.9	10.9	Wf
	4576.7	11.2	Wf	4588.7	10.8	Pw
	4578.6	11.2	Cy	4596.7	10.0	Jo
142539 V BOOTIS—						
	4536.4	8.6	Ch	4583.8	10.1	Sg
	4555.3	9.1	Ch	4584.4	9.9	Lp
	4565.7	9.5	L	4588.7	10.3	Pw
	4578 7	10.3	Cy	4589.6	9.8	Al
	4579.6	8.9	Pt	4596.7	11.0	Jo
142584 R CAMELOPARDALIS—						
	4557.2	8.8	Ch	4585.4	8.2	Lp
	4576.7	8.4	Wf	4589.6	8.0	Ie
	4584.7	8.2	Wf			
143227 R BOOTIS—						
	4356.8	8.0	Ko	4589.9	6.7	Vv
	4359.8	7.8	Ko	4389.9	6.8	Ko
	4363.8	7.6	Ko	4397.8	6.4	Ko
	4370.8	7.1	Mi	4397.9	7.1	Tu
	4375.8	7.0	Mi	4398.8	7.1	Pg
	4375.9	7.2	Ko	4400.8	7.9	Pg
	4376.8	6.9	Vv	4401 8	7.2	Pg
	4376.9	6.9	Mi	4404.8	7.2	Pg
143227 R BOOTIS—Continued.						
	4377.8	6.7	Vv	4405.8	7.2	Vv
	4378.8	7.1	Pg	4407.8	7.5	Pg
	4378.8	6.9	Mi	4408.8	7.5	Pg
	4378.9	6.6	Vv	4411.8	7.7	Pg
	4379.8	6.9	Mi	4536.4	11.8	Ch
	4383.8	6.8	Tu	4563.3	10.8	Ch
	4385.8	6.7	Mi	4579.6	9.2	Pt
	4389.8	6.9	Mi	4591.7	8.3	Gb
	4389.8	6.6	Tu			
145971 S APODIS—						
	4525.0	10.1	Bl	4546.0	10.2	Bl
	4540.0	10.2	Bl			
150018 RT LIBRAE—						
	4584.8	9.4	Pt			
150605 Y LIBRAE—						
	4565.7	12.9	L			
151520 S LIBRAE—						
	4536.4	8.5	Ch	4564.7	9.1	L
	4562.4	8.8	Ch	4584.8	9.7	Pt
151714 S SERPENTIS—						
	4565.7	13.7	L	4583.9	13.4	Wf
	4579.7	13.5	Wf			
151731 S CORONAE BOREALIS—						
	4539.4	7.8	Ch	4583.9	9.5	Wf
	4576.7	9.3	Wf	4584.8	9.4	Pt
	4583.8	9.8	Sg	4591.7	10.0	Gb
151822 RS LIBRAE—						
	4564.7	10.3	L			
152714 RU LIBRAE—						
	4564.7	11.6	L	4584.8	13.0	Pt
153215 W LIBRAE—						
	4565.7	[13.5	L			
153378 S URSAE MINORIS—						
	4536.4	9.4	Ch	4584.7	8.2	Wf
	4576.7	8.2	Wf	4584.8	8.0	Pt
154428 R CORONAE BOREALIS—						
	4254.8	6.1	Tc	4536.4	6.1	Ch
	4264.8	5.9	Tc	4543.4	6.1	Kd
	4264.8	6.0	Tc	4553.3	6.0	Ch
	4265.8	6.0	Tc	4557.3	6.1	Kd
	4267.8	5.6	Tc	4562.4	6.1	Ch
	4268 8	5.7	Tc	4563.4	6.2	Kd
	4285.8	6.2	Tc	4564.7	6.1	L
	4288.8	6.1	Tc	4566.8	6.1	Cy
	4293.8	6.0	Tc	4568.4	6.3	Kd
	4313.8	5.6	Tc	4570.9	6.0	Cy
	4314.8	5.8	Tc	4572.9	6.0	Cy
	4315.8	5.8	Tc	4578.7	5.9	Cy
	4325.8	5.8	Tc	4579.6	6.2	Pt
	4326.8	5.6	Tc	4579.7	5.8	Wf
	4327.8	5.8	Tc	4579.7	5.8	Gb
	4332.8	5.8	Tc	4580.6	6.1	Pt
	4343.8	5.9	Tc	4583.8	6.0	Sg
	4344 8	5.8	Tc	4583.9	6.1	Wf
	4345.8	5.7	Tc	4584.7	5.9	Wf
	4349.8	5.7	Tc	4584.8	6.0	Pt
	4350.8	6.0	Tc	4585.6	6.2	Ie
	4358.8	5.4	Tc	4585.7	6.0	Cu
	4380.8	5.3	Tc	4587.9	6.1	Pt
	4381.8	5.4	Tc	4588.7	6.5	Pw

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
154428 R CORONAE BOR.—Continued.						
	4387.8	5.5	Tc	4588.8	6.0	Cu
	4511.8	5.9	Tc	4588.8	6.1	Pt
	4527.3	6.3	Kd	4591.7	6.0	Gb
	4536.4	6.2	Kd	4593.7	6.0	Cu
154536 X CORONAE BOREALIS—						
	4583.9	12.9	Wf	4584.8	13.2	Pt
154615 S SERPENTIS—						
	4536.4	6.8	Ch	4562.4	6.2	Ch
	4557.3	6.3	Ch	4584.8	6.8	Pt
154639 V CORONAE BOREALIS—						
	4576.7	9.4	Wf	4584.8	8.6	Pt
	4583.9	9.9	Wf			
155018 RR LIBRAE—						
	4536.4	[11.9	Ch	4584.8	11.5	Pt
	4565.7	12.5	L			
155823 RZ SCORPII—						
	4584.8	8.3	Pt			
160021 Z SCORPII—						
	4565.7	11.2	L			
160118 R HERCULIS—						
	4536.5	11.5	Ch	4557.3	[10.3	Ch
160210 U SERPENTIS—						
	4584.8	13.0	Pt			
160325 SX HERCULIS—						
	4565.7	8.0	L	4584.8	8.1	Pt
	4579.8	8.3	Wf	4587.9	8.1	Pt
	4583.9	8.7	Wf			
160625 RU HERCULIS—						
	4565.7	10.3	L	4583.9	11.2	Wf
	4579.8	10.8	Wf	4584.8	11.0	Pt
161122a R SCORPII—						
	4584.8	12.2	Pt			
161122b S SCORPII—						
	4584.8	12.3	Pt			
161138 W CORONAE BOREALIS—						
	4579.8	11.8	Wf	4584.8	11.6	Pt
	4583.9	11.4	Wf			
161607 W OPHIUCHI—						
	4535.4	[11.0	Ch	4584.8	13.8	Pt
	4562.4	[11.4	Ch			
162112 V OPHIUCHI—						
	4584.8	8.2	Pt			
162119 U HERCULIS—						
	4579.8	12.2	Wf	4584.8	12.0	Pt
	4583.9	11.8	Wf			
162807 SS HERCULIS—						
	4564.7	12.1	L	4584.8	11.1	Pt
162815 T OPHIUCHI—						
	4584.8	11.5	Pt			
163137 W HERCULIS—						
	4540.5	10.7	Ch	4584.8	7.9	Pt
	4562.4	8.7	Ch			
163172 R URSAE MINORIS—						
	4585.4	9.6	Lp			
163266 R DRACONIS—						
	4536.4	11.2	Ch	4584.8	7.4	Pt
	4560.4	9.7	Ch	4585.4	7.9	Lp
164319 RR OPHIUCHI—						
	4584.8	13.2	Pt			
164715 S HERCULIS—						
	4536.5	9.5	Ch	4584.8	7.6	Pt
165202 SS OPHIUCHI—						
	4584.8	11.1	Pt			
165631 RV HERCULIS—						
	4584.8	12.7	Pt			
170215 R OPHIUCHI—						
	4536.5	10.5	Ch	4584.8	7.1	Pt
	4560.5	8.4	Ch			
170627 RT HERCULIS—						
	4579.8	11.3	Wf	4584.8	11.5	Pt
	4583.9	11.4	Wf			
171401 Z OPHIUCHI—						
	4584.8	9.0	Pt			
171723 RS HERCULIS—						
	4579.8	11.6	Wf	4584.8	11.8	Pt
	4583.9	11.9	Wf			
172486 S OCTANTIS—						
	4528.0	12.5	Bl			
172809 RU OPHIUCHI—						
	4584.8	13.1	Pt			
174406 RS OPHIUCHI—						
	4584.8	11.1	Pt			
175458a X DRACONIS—						
	4579.8	11.4	Wf			
175519 RY HERCULIS—						
	4540.5	[11.7	Ch	4584.8	11.0	Pt
	4562.4	11.8	Ch			
180531 T HERCULIS—						
	4540.5	8.3	Ch	4579.8	10.9	Wf
	4562.4	9.2	Ch	4583.9	11.2	Wf
	4564.7	9.8	L	4584.8	11.4	Pt
180565 W DRACONIS—						
	4584.8	10.4	Pt			
180666 X DRACONIS—						
	4584.8	11.5	Pt			
180911 NOVA OPHIUCHI—						
	4584.8	[13.0	Pt			
181031 TV HERCULIS—						
	4564.7	9.7	L			
181103 RY OPHIUCHI—						
	4583.9	7.9	Wf	4584.8	7.5	Pt
181136 W LYRAE—						
	4579.8	8.6	Wf	4584.9	8.7	Pt
182306 T SERPENTIS—						
	4584.9	12.5	Pt			
193308 X OPHIUCHI—						
	4564.7	8.2	L	4584.9	8.5	Pt
184205 R SCUTI—						
	4536.3	5.3	Kd	4571.3	5.4	Kd
	4537.3	5.3	Kd	4572.9	5.8	Cy
	4557.3	5.3	Kd	4580.9	5.7	Cy
	4560.5	4.8	Ch	4584.9	6.3	Pt
	4564.3	5.3	Kd	4585.8	6.3	Cu
	4564.7	5.4	L	4587.9	6.3	Pt
	4568.3	5.4	Kd	4588.8	6.8	Cu
	4570.9	5.7	Cy	4596.8	7.3	Cu
184300 NOVA AQUILAE—						
	4560.5	10.4	Ch	4587.9	11.0	Pt
	4584.9	10.9	Pt			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
185032 RX LYRAE—						
	4539.5	[11.0	Ch			
185512a ST SAGITTARII—						
	4560.5	[11.2	Ch			
190108 R AQUILAE—						
	4561.5	8.4	Ch	4584.9	8.7	Pt
190818 RX SAGITTARII—						
	4561.5	[10.8	Ch			
190819a RW SAGITTARII—						
	4561.5	9.4	Ch	4584.9	9.4	Pt
190907 TY AQUILAE—						
	4584.9	10.2	Pt			
190925 S LYRAE—						
	4562.4	[11.6	Ch			
190926 X LYRAE—						
	4584.9	9.0	Pt			
190933a RS LYRAE—						
	4539.5	11.5	Ch	4584.9	10.9	Pt
190967a U DRACONIS—						
	4562.4	[10.9	Ch	4584.9	12.6	Pt
191007 W AQUILAE—						
	4561.5	[11.0	Ch	4584.9	12.2	Pt
191019 R SAGITTARII—						
	4561.5	7.0	Ch	4584.9	7.4	Pt
191033 RY SAGITTARII—						
	4587.9	6.4	Pt			
191350 TZ CYGNI—						
	4584.9	10.0	Pt			
191637 U LYRAE—						
	4584.9	11.0	Pt			
192928 TY CYGNI—						
	4541.5	[11.9	Ch			
193311 RT AQUILAE—						
	4561.5	9.4	Ch	4584.9	9.2	Pt
193449 R CYGNI—						
	4540.5	9.6	Ch	4580.9	10.6	Cy
	4560.4	9.8	Ch	4584.9	10.0	Pt
	4577.6	10.4	Wf			
193972 TS PAVONIS—						
	4521.0	8.2	Bl	4539.0	8.3	Bl
	4528.0	7.5	Bl	4546.0	8.4	Bl
194048 RT CYGNI—						
	4560.4	9.4	Ch	4584.9	7.8	Pt
	4580.9	8.4	Cy			
194348 TU CYGNI—						
	4540.5	9.8	Ch	4584.9	9.0	Pt
	4560.4	8.8	Ch			
194604 X AQUILAE—						
	4583.9	11.5	Wf	4584.9	11.9	Pt
194632 χ CYGNI—						
	4515.9	5.8	Kd	4539.3	5.0	Kd
	4516.9	5.7	Kd	4540.5	4.5	Ch
	4519.9	5.7	Kd	4557.3	5.0	Kd
	4522.9	5.4	Kd	4559.5	4.6	Ch
	4524.9	5.3	Kd	4562.4	5.0	Ch
	4528.9	4.9	Kd	4564.3	5.0	Kd
	4535.9	5.0	Kd	4570.3	5.0	Kd
	4536.3	5.1	Kd	4584.9	5.3	Pt
195553 NOVA CYGNI—						
	4561.5	[11.5	Ch	4587.9	12.8	Pt
	4584.9	12.7	Pt			
195849 Z CYGNI—						
	4560.6	9.6	Wf	4584.9	10.8	Pt
	4561.4	9.7	Ch	4577.6	10.5	Wf
195855 S TELESCOPII—						
	4525.0	[12.6	Bl			
200212 SY AQUILAE—						
	4584.9	8.8	Pt			
200357 S CYGNI—						
	4560.6	[14.7	Wf	4577.6	[14.5	Wf
200514 R CAPRICORNI—						
	4584.9	10.9	Pt			
200715a S AQUILAE—						
	4584.9	11.0	Pt			
200715b RW AQUILAE—						
	4584.9	9.1	Pt			
200906 Z AQUILAE—						
	4584.9	9.0	Pt			
200916 S SAGITTARII—						
	4588.9	9.1	Cu			
200938 RS CYGNI—						
	4536.0	7.8	Ch	4561.5	7.7	Ch
	4538.0	7.9	Ch	4564.7	7.2	L
	4540.5	7.8	Ch	4580.9	7.6	Cy
	4560.4	7.7	Ch	4584.9	7.4	Pt
201008 R DELPHINI—						
	4584.9	11.4	Pt			
201130 SX CYGNI—						
	4584.9	13.6	Pt			
201437b WX CYGNI—						
	4560.4	10.7	Ch	4584.9	11.1	Pt
	4580.9	11.4	Cy			
201647 V CYGNI—						
	4584.9	8.3	Pt			
202240 U MICROSCOPII—						
	4521.0	10.2	Bl			
202946 SZ CYGNI—						
	4566.5	9.5	Pt	4575.5	9.4	Pt
	4567.5	9.4	Pt	4576.5	9.7	Pt
	4570.5	9.1	Pt	4584.9	9.0	Pt
	4574.5	9.3	Pt	4587.9	8.9	Pt
202954 ST CYGNI—						
	4584.9	13.0	Pt			
203226 V VULPECULAE—						
	4584.9	9.4	Pt			
203816 S DELPHINI—						
	4584.9	11.4	Pt			
203847 V CYGNI—						
	4540.0	8.7	Ch	4577.6	8.4	Wf
	4560.5	8.5	Ch	4584.9	7.5	Pt
	4560.6	8.4	Wf			
204318 V DELPHINI—						
	4588.9	11.6	Cu			
204846 RZ CYGNI—						
	4560.6	12.2	Wf	4584.9	12.0	Pt
	4577.6	12.0	Wf			
204954 S INDI—						
	4525.0	[13.1	Bl			
205923a R VULPECULAE—						
	4587.9	10.4	Pt			
210382 X CEPHEI—						
	4588.8	10.5	Cu			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
210868 T CEPHEI—						
	4313.9	6.7	Pg	4360.8	6.2	Vv
	4316.9	6.5	Ko	4360.9	6.2	Pg
	4318.9	7.0	Vv	4362.0	6.4	Vv
	4323.9	6.0	Ko	4362.9	6.3	Vv
	4323.9	6.6	Pg	4363.8	6.2	Pg
	4324.9	6.4	Vv	4363.9	6.2	Pg
	4325.9	6.6	Vv	4363.9	6.4	Vv
	4326.8	6.5	Vv	4363.9	6.2	Ko
	4326.9	6.1	Ko	4370.8	6.2	Pg
	4327.9	6.2	Ko	4370.9	6.2	Pg
	4327.9	6.4	Vv	4375.8	6.3	Pg
	4327.9	6.3	Pg	4375.8	6.4	Vv
	4328.9	5.9	Ko	4375.9	6.5	Ko
	4328.9	6.4	Vv	4376.8	6.5	Vv
	4328.9	6.2	Pg	4376.9	6.7	Ko
	4329.8	6.3	Vv	4377.8	6.7	Ko
	4331.8	6.3	Vv	4377.8	6.7	Vv
	4332.8	6.0	Ko	4377.9	6.4	Pg
	4333.0	6.3	Vv	4378.8	6.4	Pg
	4333.9	6.2	Vv	4378.8	6.6	Vv
	4334.8	6.1	Ko	4380.9	6.5	Pg
	4334.9	6.2	Vv	4389.8	6.7	Pg
	4335.8	6.0	Vv	4389.8	6.8	Vv
	4336.9	6.1	Vv	4389.8	6.6	Ko
	4337.9	6.0	Vv	4392.0	7.7	Vv
	4337.9	6.1	Pg	4397.8	7.1	Ko
	4338.9	5.7	Ko	4397.8	6.9	Pg
	4340.9	6.1	Vv	4398.7	6.9	Pg
	4341.9	6.0	Vv	4400.8	7.0	Pg
	4342.9	6.2	Vv	4401.8	7.0	Pg
	4343.9	6.1	Vv	4404.8	7.1	Pg
	4343.9	5.4	Ko	4405.7	7.2	Pg
	4344.9	5.5	Ko	4405.7	7.6	Vv
	4344.9	6.1	Vv	4406.9	7.9	Vv
	4346.0	6.0	Vv	4407.7	7.7	Pg
	4346.9	6.1	Vv	4408.8	7.3	Pg
	4348.0	6.1	Vv	4409.8	7.5	Pg
	4349.0	6.1	Vv	4409.9	8.0	Vv
	4350.0	6.1	Vv	4410.8	7.6	Pg
	4350.8	5.9	Ko	4411.8	7.6	Pg
	4350.9	6.1	Vv	4415.7	7.8	Pg
	4350.9	6.0	Pg	4415.7	8.0	Vv
	4351.9	6.2	Vv	4416.7	7.8	Pg
	4353.0	6.2	Vv	4417.7	7.9	Pg
	4353.8	6.2	Vv	4417.7	8.4	Vv
	4354.8	5.7	Ko	4418.7	8.0	Pg
	4354.9	6.0	Pg	4419.8	8.0	Pg
	4355.0	6.2	Vv	4434.8	9.4	Vv
	4355.9	6.1	Pg	4435.8	9.2	Vv
	4356.9	6.2	Vv	4438.7	9.4	Vv
	4356.9	5.9	Ko	4440.7	9.5	Vv
	4357.9	6.1	Pg	4446.8	8.5	Ko
	4358.0	6.3	Vv	4446.8	8.6	Pg
	4358.8	6.2	Pg	4560.5	9.9	Ch
	4358.8	6.3	Vv	4461.7	8.9	Pg
	4358.9	6.1	Pg	4562.3	9.8	L
	4359.9	6.0	Ko	4575.6	9.5	Cy
	4360.0	6.3	Vv	4584.9	8.7	Pt
211614 X PEGASI—						
	4584.9	9.8	Pt			
213244 W CYGNI—						
	4515.9	6.5	Kd	4528.9	6.4	Kd
	4519.9	6.5	Kd	4557.3	6.1	Kd
	4522.9	6.4	Kd	4570.3	6.0	Kd
213678 S CEPHEI—						
	4575.6	9.2	Cy	4587.9	8.4	Pt
	4584.4	9.5	Lp			
213753 RU CYGNI—						
	4575.5	6.8	Cy	4587.9	7.3	Pt
213843 SS CYGNI—						
	4536.0	8.8	Ch	4577.6	11.8	Wf
	4537.0	8.8	Ch	4578.5	11.7	Pt
	4538.0	8.8	Ch	4579.5	11.6	Cu
	4539.0	9.0	Ch	4579.6	11.7	Pt
	4540.0	9.0	Ch	4580.6	11.6	Wf
	4542.0	9.6	Ch	4580.9	11.5	Cy
	4542.2	9.8	Kl	4581.5	11.6	Cu
	4552.0	11.8	Ch	4581.6	11.3	Wf
	4560.6	11.9	Wf	4582.6	11.5	Wf
	4561.2	12.1	L	4583.9	11.8	Wf
	4562.2	12.0	L	4584.5	11.6	Cu
	4565.3	11.8	L	4584.6	11.5	Wf
	4566.2	12.0	L	4584.9	11.7	Pt
	4566.5	11.7	Pt	4585.8	11.6	Cu
	4567.5	11.7	Pt	4587.9	11.7	Pt
	4570.5	11.3	Ie	4588.5	11.1	Cu
	4574.5	11.6	Pt	4588.9	11.6	Cu
	4575.5	11.7	Pt	4593.8	9.0	Cu
	4575.6	11.9	Wf	4596.8	9.9	Cu
	4576.6	11.8	Wf			
213937 RV CYGNI—						
	4587.9	6.4	Pt			
214024 RR PEGASI—						
	4560.6	[13.4	Wf			
214247 R GRUIS—						
	4525.0	[12.9	Bl			
222439 S LACERTAE—						
	4559.0	[10.0	Ch			
222867 R INDI—						
	4521.0	9.0	Bl	4539.0	10.6	Bl
	4528.0	9.7	Bl	4546.0	11.6	Bl
223841 R LACERTAE—						
	4559.0	[10.4	Ch			
230110 R PEGASI—						
	4560.6	11.9	Wf			
230759 V CASSIOPEIAE—						
	4565.5	12.0	B	4578.6	12.5	Cy
	4578.5	12.4	B			
232848 Z ANDROMEDAE—						
	4559.1	9.9	Ch	4576.5	9.8	Pt
233335 ST ANDROMEDAE—						
	4552.1	10.4	Ch	4576.5	10.6	Pt
233815 R AQUARII—						
	4552.1	9.8	Ch			
233956 Z CASSIOPEIAE—						
	4560.6	12.6	Wf	4578.6	13.0	Cy
	4577.6	12.8	Wf			
235053 RR CASSIOPEIAE—						
	4559.1	[10.2	Ch	4578.5	10.8	B
	4565.5	11.1	B			

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1926—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
235209 V CETI—							235525 Z PEGASI—						
	4521.0	11.5	Bl	4528.0	12.0	Bl		4576.5	11.4	Pt			
235350 R CASSIOPEIAE—							235939 SV ANDROMEDAE—						
	4558.1	11.6	Ch	4578.6	11.4	Cy		4576.5	9.5	Pt			

Total observations, 1612; stars observed, 314; total observers, 30.

to the magnitude 5.5 and underwent several peculiar and remarkable changes in light during the course of the first few months of its career. Thanks to the diligence of some of the southern observers, the light curve has been very completely observed.

The following observers have contributed to this report of observations received during the month of March, 1926: Allen, "Al"; Baldwin, "Bl"; Berman, "Bi"; Bouton, "B"; Chandra, "Ch"; Cilley, "Cy"; Miss Cunningham, "Ci"; Cunningham, "Cu"; Gaebler, "Gb"; Miss Groce, "Gc"; Miss Hawes, "Hs"; Miss Hill, "Hi"; Iedema, "Ie"; Jones, "Jo"; Kanda, "Kd"; Köhl, "Kl"; Koslov, "Ko"; Lacchini, "L"; Leavenworth, "Lv"; Lepper, "Lp"; Maiseiv, "Mi"; Murdoch, "Mh"; Parenago, "Pg"; Peltier, "Pt"; Skaggs, "Sg"; Tchernov, "Tc"; Türk, "Tu"; Vorontsov-Velyaminov, "Vv"; Waterfield, "Wf"; Watson, "Pw".

LEON CAMPBELL, Recording Secretary.

April 12, 1926.

COMET NOTES.

Comet 1925 *l* (Ensor).—It is reported that this comet was photographed at Bergedorf on March 16 and 20. The photograph on March 20 was given an exposure of two and one-half hours. The comet was of magnitude 13, showing no nucleus, but having a tail at position angle 250°, spread at an angle of 10° and of length about one-half degree, forked at 20′ distance. The correction to the ephemeris on March 20 was $+0^m4$, $-3'$.

Ephemeris of Tuttle's Comet (1926*a*).

U.T. 1926		α	δ	Log *r*	Log Δ
		h m s	° ′ ″		
June	1	6 34 43	— 7 45 10	0.05974	0.22399
	5	6 48 21	— 9 45 31	0.06990	0.22526
	9	7 2 9	—11 44 32	0.08056	0.22698
	13	7 16 7	—13 41 57	0.09160	0.22925
	17	7 30 18	—15 37 34	0.10294	0.23206
	21	7 44 41	—17 30 55	0.11446	0.23550
	25	7 59 14	—19 21 4	0.12604	0.23960
	29	8 13 57	—21 8 4	0.13770	0.24442

The above is an ephemeris of Tuttle's Comet (1926*a*) for the month of June, 1926. It is based upon elements published in a recent number of *The Observatory*. The comet will be very *unfavorably* situated for northern observers.

F. E. SEAGRAVE.

Boston, April 4, 1926.

New Elements and Ephemeris of Comet 1925 *j* (Van Biesbroeck).—In the *Lick Observatory Bulletin*, No. 376, new elements of Van Biesbroeck's comet are given by A. D. Maxwell and L. C. Damsgard, calcu-

lated from observations by Jeffers at Lick Observatory on Nov. 18, 1925, January 1 and March 11, 1926.

ELEMENTS OF COMET 1925 *j* (VAN BIESBROECK).

T = 1925 Oct. 2.93610 U.T.
ω = 106° 25′ 32″.9
Ω = 334 34 39.3 } 1926.0
i = 49 20 42.1
log q = 0.195092

A portion of the ephemeris for May and June follows:

EPHEMERIS FOR GREENWICH MIDNIGHT.

1926, U. T.		True α	True δ	log Δ	Br.
		h m s	° ′		
May	4.0	9 35 59	—0 23.2	0.435	0.11
	6.0	36 31	35.5		
	8.0	37 07	—0 47.8		
	10.0	37 48	—1 00.1		
	12.0	38 32	12.4	0.465	0.09
	14.0	39 20	24.6		
	16.0	40 11	36.9		
	18.0	41 05	—1 49.3		
	20.0	42 02	—2 01.6	0.492	0.08
	22.0	43 02	14.0		
	24.0	44 05	26.4		
	26.0	45 11	38.9		
	28.0	46 18	—2 51.5	0.518	0.07
May	30.0	47 29	—3 04.1		
June	1.0	48 41	16.7		
	3.0	49 56	29.5		
	5.0	51 12	42.3	0.542	0.06
	7.0	52 31	—3 55.2		
	9.0	53 51	—4 08.2		
	11.0	55 13	21.3		
	13.0	56 37	34.4	0.565	0.05
	15.0	58 02	—4 47.7		
	17.0	9 59 29	—5 01.1		
	19.0	10 00 57	14.6		
	21.0	02 26	28.1	0.586	0.04
	23.0	03 57	41.8		
	25.0	05 29	—5 55.6		
	27.0	07 01	—6 09.5		
June	29.0	08 35	23.5	0.606	0.04
July	1.0	10 10	37.6		
	3.0	11 45	—6 51.8		
	5.0	13 21	—7 06.1		
July	7.0	10 14 58	—7 20.5	0.624	0.03

The unit of brightness is that of January 1.

Search Ephemerides for Finlay's Periodic Comet.

[*Continued from page 277.*]

0h U.T.		Perihelion June 19.0 α 1926.0	δ 1926.0	Perihelion June 27.0 α 1926.0	δ 1926.0	Log Δ
		h m	° ′	h m	° ′	
June	3	1 46.7	+ 8 48	1 25.8	+ 6 23	0.146
	11	2 21.8	+12 13	2 01.2	+10 00	0.147
	19	2 56.8	+15 16	2 36.8	+13 19	0.152
	27	3 31.5	+17 53	3 12.3	+16 15	0.160
July	5	4 05.4	+20 01	3 47.2	+18 04	0.170
	13	4 38.3	+21 39	4 21.2	+20 38	0.182
	21	5 09.8	+22 48	4 53.9	+22 05	0.194
	29	5 39.7	+23 32	5 25.1	+25 03	0.206

Comet 1926 *a* (Tuttle).—Professor B. Numeroff, Director of the Astronomical Institute, Fontanka 34, Leningrad, U. S. S. R. (Russia) wishes to bring to the attention of American observers that observations of Comet Tuttle (1926 *a*) would be greatly appreciated by the Institute. He asks that all communications be sent to the address given above. The following ephemeris was computed by N. Idelson and M. Musselius of the staff of the Astronomical Institute:

Universal Time 1926	α 1926.0 h m s	δ 1926.0 ° ′	Log *r*
May 2	4 55 32	+7 21.5	0.014
4	5 02 08	6 22.4	
6	5 08 42	5 23.0	0.016
8	5 15 16	4 23.2	
10	5 21 50	3 23.2	0.019
12	5 28 24	2 22.9	
14	5 34 57	1 22.4	0.024
16	5 41 31	+0 21.9	
18	5 48 06	−0 38.9	0.030
20	5 54 41	1 39.7	
22	6 01 17	2 40.5	0.037
24	6 07 54	3 41.4	
26	6 14 33	4 42.2	0.046
28	6 21 14	5 43.0	
30	6 27 57	6 43.7	0.055
June 1	6 34 42	−7 44.1	

Log ρ: May 4 0.222; May 26 0.223.

—O. S.

COMMUNICATIONS.

The Southern Cross Observatory.—The 1926 season of the Southern Cross Observatory, the outdoor institution at Miami, Fla., closed March 23. The observatory is operated for public education without charge and is the gift of S. Lynn Rhorer of Atlanta, a member of the American Association of Variable Star Observers. Four five-inch Clark refractors were in use during the three months of the season, as was also a small spectroscope furnished to the observatory by Dr. Shapley. The staff was augmented by several notable additions to a membership of ten fellows, who were assisted at times by experienced amateurs visiting the city. While the conditions were inferior to last year, due to several cool spells, increase of smoke in the city and cloudy nights, fully 90 percent of the evenings gave excellent seeing. The attendance records were broken and on several Sunday evenings in January the incredible number of 2,000 visitors were entertained. The lines at each of the four telescopes at times reached a hundred feet in length, while the groups surrounding any member of the staff who conducted informal lectures resembled the local real estate auction.

Several notable accessions during the season to the staff personnel included Clarendon Ions, who was honored by election to the fellowship of the Royal Astronomical Society during the year. Dr. L. R. Fletcher, D. H. Redfearn and Mr. Ions have made Miami their residence, and these with the older members give the observatory a strong staff.

The local newspapers have given the work much publicity. Mr. Ions and William Tyler Olcott contributed several feature stories for the Sunday editions of the Miami Herald on the Orion nebula, star distances and the observatory work, while Mr. Rhorer and the Secretary prepared daily articles of a few

hundred words each on objects of interest. Mr. Olcott also contributed a few of these articles. The other newspapers of the city gave considerable space and will continue to publish articles during the summer.

Dr. Shapley spoke here on February 27 on "Beyond the Milky Way." The largest auditorium in the city was engaged, but its capacity of 1500 was exhausted some time before the commencement of the lecture. Dr. Shapley was much impressed with the responsiveness of the audience and characterized it as the most alert he had ever addressed. His remarks dealt with the new methods of Cepheid variable measurements.

At the telescopes the principal objects of interest were the moon, Venus, the Orion and Andromeda nebulae; Castor, Mizar, Gamma Andromedae, Gamma Leonis, Polaris, Beta Velae, Sigma Orionis and Regulus among the doubles; the Pleiades, Bee Hive, Theta Centauri and the double cluster in Perseus among the clusters, and to the naked eye, Sirius, Canopus, Achernar, the Southern Cross, Alpha and Beta Centauri and the constellations. As Miami is on the 26th degree of latitude, the southern figures were of great interest. Mercury was in the western sky for two weeks during March. A diligent search failed to reveal any of the comets.

The observatory will add another five-inch refractor and a ten-inch reflector for the 1927 season. A better location has been obtained in the new city park on the bay front, with additional facilities. Any observer with experience is urged to communicate with any of the members of the staff after January 1 and to lend his assistance in the work.

JAMES J. MARSHALL, Secretary.

The Sun's Negative Rays.—Having in 1925 constructed an instrument with which I hoped to be able to measure such natural forces as those of attraction, it was of course a great surprise to me to find that the attractometer, as my instrument was called, showed that a very powerful repelling force was coming from the sun. Later on when the attraction of the moon was measured with the same instrument this force seemed to have only about 1/40 of the power of the sun's R. P. rays.

As the attractometer showed that these rays penetrated the earth's atmosphere with comparative ease, I was for a considerable period of time led to believe that these rays had great penetrating power. Difficult experiments however proved that these rays are rather soft, not even being able to penetrate three thicknesses of boards. The power of these rays is greatly reduced when they have to penetrate depths of the earth's atmosphere, such as would be the case in the morning at sunrise, when the attractometer would register their power as they traveled parallel to the earth's surface. The power of the R. P. rays is sometimes reduced as much as 25 percent when the earth's atmosphere is heavily laden with dense clouds or when a heavy rain storm is in progress.

The power of these R. P. rays is so great that they completely wash out on the attractometer any influence that the combined attractions of the sun and moon might show, were they not present.

Now, if the R. P. rays are as powerful as the attractometer shows them to be, we might well conclude that they should make their presence known, and they do, for scientific men have detected a mysterious influence at work which may or may not have been these R. P. rays. It however occurred to me that, if these rays were as powerful as they seemed to be, they should show this power by having a flattening influence upon the earth's atmosphere or, in other words, cause a tidal

effect, so a sensitive barometer of the mercury type was constructed in order to enable me to measure the weight of the atmosphere and by so doing to ascertain if a tidal effect was actually taking place, and these experiments soon showed that it was. The period of low pressure followed the sun by several hours. These experiments can be easily duplicated by others.

Another very spectacular and convincing way in which the great power of the sun's R. P. rays can be proved or seen at work is by noting the effect they have upon comets, for astronomers well know that comets do not begin to have tails until they begin to approach the sun and reach their greatest length as the comet rounds the sun, and diminish and finally disappear as it moves away. Another strange thing in regards to comets' tails is that the sun's R. P. rays at all times push these tails away from the sun. The tail trailing the comet as it approaches the sun and going before it as it moves away.

As comets are composed of light nebulous matter it is easy to see that as they approach the sun the sun's R. P. rays would easily influence this and push it around behind the comet to form a tail. In order to do this it would of course be necessary that the comet's attraction, which under other conditions would keep it in a more or less spherical form, would to some extent have to be overcome and if we will but study the effect these R. P. rays have upon our own atmosphere it will be easy to see why they affect comets as they do. It is my opinion that these R. P. rays prevent the sun's attraction from drawing comets into it for these rays have a double form of energy while the sun's attraction is constant.

H. J. SMITH.

Minneapolis, Minn., April 4, 1926.

Auroral Display April 14.—At about 8:40 P. M. April 14 the sky was somewhat illuminated in the north and northeast by what seemed to be northern lights, with faint narrow streamers indistinctly visible from time to time. At a point in the southeast a very bright fairly steady stream of light extended from the (natural) horizon (over Mt. Sentinel, hence at an altitude of nearly 15°) in an arc through the southern sky and over into the northwest. Its east end was about 35° south of east, and somewhat south of Spica, between Spica and Corvus. It followed very closely the ecliptic, being somewhat south most of the time. Its west end was some 15° north of west at the moon, some 15° above the horizon. Persons who had seen the light earlier informed me that the band had appeared over the horizon at about 8:30, and had been increasing in height until it reached the dimensions given above. It was some 10° in width, and at its maximum 125°-135° in length. In brightness it easily surpassed all ordinary northern lights. After it had extended some distance into the sky, a rift appeared near its eastern end. The portion in the southern sky later broke into vertical laminae, with faint streamers upward. These laminae seemed to progress westward—"soldiers marching," and the whole stream had much the appearance of smoke driven by a fresh breeze.

In the meantime the east end drifted to the south some 15° or 20°. It then died out at the eastern end, but its trail remained visible, stretching out toward the moon for at least 10 minutes after it began to disappear.

Then at 9:15 a second streamer appeared in the same place the first one had started and in the same way; this latter being the testimony of those who had seen the first one before I did. The following phenomena were similar to those in connection with the first; the rift and the formation of laminae. This one did not last so long as the first one, nor did it stretch out so far to the west. In brighness it very nearly equalled the first.

In 14 or 15 minutes, that is at 9:29 or 9:30, a third streamer appeared in the same place, the second having drifted southward, and then having died out at its east end. This third one was much less bright except at the very start. It extended up into the sky only about 30°, then disappeared less than 10 minutes after its first appearance.

Three meteors were observed in quick succession within, or crossing, the band of light during the time the second streamer was visible.

During all these phenomena, the lights in the north and northeast continued, but not brilliantly. As the third ecliptic streamer disappeared, the brightness which had until then been limited to the north and northeast, spread to the east and somewhat south of east, though not so far as the point from which the ecliptic streamers had started.

By 9:40 the true northern lights had become much brighter, with an arc (night rainbow) from east to north 65° west, at an altitude of some 35° at its highest point in the northeast. The streamers were all below this. In the course of the next hour these streamers increased in length. By 10:30 the arc had disappeared and by 10:50 the streamers were more brilliant than ever and extended practically to the zenith. While there was no remarkable coloring, the display was now very bright. In half an hour more, the north was in darkness, but at about 1:00 A. M., according to the newspaper report there was another brilliant display.

Judging from the newspaper reports, this whole auroral display was observed to be much the same in Butte, Montana, and Livingston, Montana. Some auroral phenomena seem to have been observable in other parts of the country, but I have not yet seen any report of the observance of the ecliptic streamers except in this general locality.

A. S. MERRILL.

Missoula, Montana, April 15, 1926.

GENERAL NOTES

Nova Geminorum 1912. — Dr. W. H. Steavenson has reported that when observing this Nova with the 28-inch refractor of the Royal Observatory on January 9, he found it to be involved in a faint nebulosity which extended to a distance of about 4″ in every direction. The image of the Nova (mag. 14 about) appears to be perfectly stellar. (G. Merton in B. A. A. Circular No. 41.)

The Motions and Distances of Spiral Nebulae. — This subject has been of great interest and has aroused a great deal of discussion in the last few years. In a recent number of *Monthly Notices*, Dr. Knut Lundmark gives the results of his investigations of the problem from several points of view, using material gathered by himself and others. Two methods of attack are open, direct and indirect. Under direct methods are those involving trigonometric parallaxes, proper motions, radial velocities, internal motions and measures of absorption of light in space. Indirect methods involve the novae in spirals, Cepheid variables, the relation between the radiation per unit of mass as developed by Oepik, Jeans' theoretical calculation of the mean distance between adjacent nuclei in the spiral arms, and star counts with assumptions as to maximum luminosity. Some of the results obtained by Dr. Lundmark by the various methods follow.

1. All efforts to obtain parallaxes of spiral nebulae by trigonometric methods

have failed. 2. The sun is moving toward the region R. A. 313°, Dec. +73°, with respect to the spiral nebulae with a velocity of 657 km per second. Combining this high velocity with the almost negligible proper motions of the spirals shows them to be at great distances with a minimum possible value of 30,000 light-years. 3. While on a visit at the Mt. Wilson Observatory Dr. Lundmark measured the same plates formerly used by Dr. van Maanen to determine the rotation of the large spiral M 33. At a distance of 7'.6 from the center van Maanen's measures gave a rotation period of 230,000 years while Lundmark's measures gave a period of 2,800,000 years. Van Maanen's results for other nebulae gave distances from 10,000 to 40,000 light-years while Lundmark's measures indicated values between 40,000 and 160,000 light-years. 4. By measuring the effective wave-length of the light of spirals Lundmark and Lindblad find indications that the distance of the Andromeda nebula is 1,000,000 light-years and that there is a very small but measurable general absorption of light in space. 5. Assuming that the novae which have been found in the last few years in the Andromeda nebula have the same mean absolute brightness as the novae in our own stellar system the distance of this nebula is 1,400,000 light-years and its diameter 60,000 light-years. 6. Depending on certain assumptions in connection with the proper motions of the Cepheid variables in our stellar system the distance of the Andromeda nebula lies between 620,000 and 1,500,000 light-years when applying the period-luminosity law to the Cepheid variables discovered by Hubble in this nebula. 7. Using the measures of Pease for the rotation of N. G. C. 4594 andOepik's method, the distance of this spiral has the enormous value of 56,000,000 light-years. Its diameter then becomes 110,000 light years and its mass 30 billion times that of the sun. 8. On the assumption that the brightest stars in Mt. Wilson photographs of M 33 have an absolute magnitude of —7, its distance is 1,500,000 light-years.

The final conclusion of the discussion is that the spiral nebulae in general are stellar systems comparable with our own and that they conform in their general distribution to a system of galaxies and super-galaxies of an infinite universe in which the total luminosity and gravitational attraction are finite, according to a plan originally formulated by Lambert and recently modified by Charlier.

The Atmosphere of Mars. — In the *Astrophysical Journal* for January, 1926, Dr. Donald H. Menzel gives the results of a theoretical investigation on the atmosphere of Mars. He states the well-known fact that the appearance of a planet depends upon the selective absorption and scattering of its atmosphere. Using the known values of the visual and photographic albedos he developes the mathematical expressions required and reaches the conclusion that the amount of atmosphere per unit of surface on Mars is not greater than one-fifth that above the earth. Under the lesser gravity, the corresponding pressure will be less than 5 cm of mercury—equivalent to the pressure in the terrestrial atmosphere at a height of 18 km. In view of this he holds that the polar caps are not atmospheric phenomena, as suggested by Wright about two years ago, but must be surface phenomena.

Big Russian Telescope Fails in Tests.—The United States still has the world's largest refracting telescope. The 41-inch instrument for the observatory at Simeis, in the Crimea, with a lens one inch larger than the famous 40-inch telescope of the Yerkes Observatory in Wisconsin, has failed to meet the tests recently given it, according to authoritative information received here.

The lens of the new telescope was made by the Parsons firm at Newcastle, England, but, it is stated, "during the examination of the glass it was found that

the whole 41-inch lens is absolutely useless. The glasses were bought on the condition that they stand the various tests. In any case, it is known with some certainty that not a single European firm is willing to make and figure a lens of even 30 inches in diameter."

A 40-inch reflecting telescope, with a concave mirror instead of a lens to form the image, has been erected at Simeis, however, and has proven so satisfactory that it is expected to have it in operation by summer. This is not the largest of its kind, for in the United States alone there are five reflectors that equal or exceed it in size, including the 100-inch telescope at the Mt. Wilson Observatory in California, the largest in the world.

The observatory at Simeis is a branch of one at Pulkovo, near here, which has the largest refracting telescope in Russia, with a lens 30 inches in diameter. When this was completed in 1885 it was the largest in the world. At that time it was not found possible to have it made in Europe. The lens was finally made by Alvan Clark, in Massachusetts, who later made the 36-inch lens for the Lick Observatory in California, as well as the 40-inch for the Yerkes Observatory.

Though most of the world's largest lenses have been made in the United States, most of their makers have died, and there is evidence that the art of making them is becoming lost, though there are several American glass workers who have had experience with lenses of more than moderate size (*Science Service Correspondence*, Leningrad, April 00.)

April Meteors Follow Path of Halley's Comet.—Nearly half a century will elapse before Halley's comet will again visit the regions of the earth, but if you look to the northeastern sky about the twenty-ninth of April and see some shooting stars, the chances are that you are observing some of the pieces of this famous comet. As these shooting stars, or meteors, come from a point in the constellation of Aquarius, the water bearer, which rises in the east before the sun, ambitious persons, starting out on pre-breakfast golf-games, before sunrise, have the best chance of seeing them.

Though these meteors seem to move along paths radiating from a point in Aquarius, near the star "eta Aquarii", they are actually moving in parallel orbits. Just as the rails of a track seem to come together in the distance, the perspective effect makes the meteors seem to come from a certain point, which astronomers call the radiant. The meteors always move along the same general path, and when, in April, the earth crosses it, the shooting stars are seen, giving rise to an unusually large number of meteors in a night, or an actual "meteor shower."

The meteors of the April shower, technically known as the "eta Aquarids," have been observed for many years at the same season, and it has been shown by an American astronomer, Dr. Charles P. Olivier, of the Leander McCormick Observatory at the University of Virginia, that the path through which this shower moves corresponds closely with that of Halley's comet. So in these shooting stars, we apparently have some of the material given off by this famous comet hitting the earth's atmosphere, and then, by friction, becoming incandescent.

Observations of meteors form one branch of astronomy in which the amateur can greatly aid the professional stargazers, for to find the exact path of a meteor, to tell how high it was when it first began to glow and to determine the direction from which it was coming, requires a large number of observations. Dr. Willard J. Fisher, of the Harvard College Observatory, is studying meteors and has received many valuable reports from persons who are not astronomers.

A good way of obtaining an accurate, and permanent, record, is by the use of photography, and the better the camera, and the faster the lens and the plate

or film, the more meteors may be caught. At the Harvard Observatory the sky is photographed in sections every clear night, so that hundreds of thousands of plates have been obtained. On many of these Dr. Fisher has found trails of previously unnoticed meteors, but the amateur photographer can in many cases get records just as good.

Though the greatest display is on May 5, the meteors may be seen from April 29 to May 8, and on any of these nights it may pay you to try your hand at photographing meteors with your kodak.

The camera must be on some firm support, as a tripod, and pointed to the northeastern sky, the lens being opened to the widest extent. Keep the shutter opened for an hour at a time, between changing the film, and note the exact standard times of opening and closing the shutter. The Harvard College Observatory, at Cambridge, Mass., is always glad to get such negatives, because even though they may not seem to show any meteors, the keen eyes of the astronomers may find some. In this way, you may help astronomers to learn more of these bodies which float into the earth's environs from outside space. (*Science News Letter,* April 17, 1926.)

Washburn Observatory Publications. — Volume XIV, part 2 of the *Publications of the Washburn Observatory,* contains a catalogue of 688 stars whose positions were determined by the late Professor A. S. Flint with the Repsold Meridian Circle. Of these stars, 267 were "proper motion stars," or stars used for reference in determining the proper motions of faint stars near them.

The Jupiter Family of Comets. — In the report of the proceedings of the meeting of the Royal Astronomical Society on February 12, 1926, (*The Observatory,* March, 1926) are given the following remarks by Dr. A. C. D. Crommelin concerning the Jupiter family of comets:

". . . . Jupiter's family of comets is being added to, but at the same time there is loss by wastage. The comets of Biela and Brorson are written off as defunct, also the 1st Tempel Comet, while Holmes' Comet has not been seen since 1906. There was a carefully-predicted apparition in 1919 under favorable conditions, but it could not be found, in spite of Dr. Baade's photographic search. Owing to its mysterious changes in brightness, we need not yet quite give up hope of its being seen again. It is due in the present year, but since the death of Dr. Zwiers no one has undertaken the calculation of its perturbations.

"One of Jupiter's family of comets is Wolf's, discovered in 1884. Prof. Kamienski, the Director of Warsaw Observatory, has calculated its motion and perturbations for the whole period from 1884 to date. Owing to its recent very close approach to Jupiter, it has suffered enormous perturbations, which have diminished its eccentricity from .559 to .405, and increased its period by 1½ years and its perihelion distance by a unit. It is now an object of the 15th or 16th magnitude, but so accurate was Prof. Kamienski's calculation of these huge changes that Dr. Baade photographed it last July at the time of the I. A. U. meeting at Cambridge within 5 minutes of arc of its predicted position. Prof. Kamienski has also carried his calculation backwards, and found that a similar close approach to Jupiter occurred in 1874. Before that date the orbit was almost identical with the present orbit. This demonstrates that Jupiter's perturbations are not always in the same direction; they are as likely to increase the period as to diminish it. This increases the difficulty in supposing that the Jupiter family of comets were formerly moving in parabolas. My own view is that they originate from eruptions on Jupiter and not from capture."